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IDENTIFIERS Oregon

ABSTRACT

This document is a workbook for drafting students learning advanced print reading for electricity applications. The workbook contains seven units covering the following material: architectural working drawings: architectural symbols and dimensions: basic architectural electrical symbols: wiring symbols: riser diagrams: schematic diagrams: and special applications. Final quizzes for each unit are included at the end of the workbook. Each unit contains an objective, introduction, information sheets, self-assessment quiz with answers provided, and a study guide including references for further information. The materials are illustrated with line drawings. (KC)

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ED204545

Drafting

Advanced Print Reading - Electrical

Architectural working drawing
Architectural symbols and dimensions
Basic architectural electrical symbols
Wiring symbols
Riser diagrams
Schematic diagrams
Special Applications

CE029458

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Drafting

Architectural Working Drawings

Plot Plan
Floor Plan
Foundation Plan
Elevations
Details
Interior Elevations
Mechanical Plans

Goal:

The student will be able to identify basic architectural drawings.

Performance Indicators:

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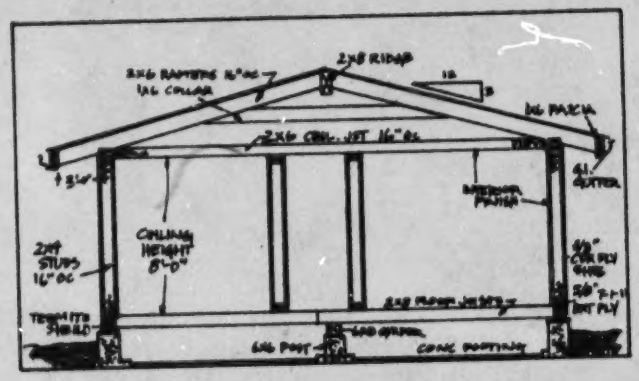
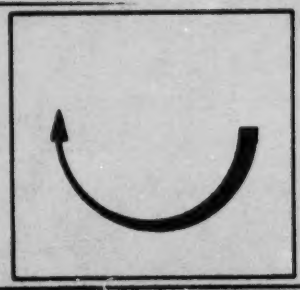
Introduction



Electricians and electrical contractors are constantly working with structures. Along with being able to understand and read all types of electrical drawings they must be able to fully understand and read the architectural drawings they will be using.

It is suggested that those persons dealing in depth with architectural drawings also work in "advanced blueprint reading, construction" for a more indepth study of architectural working drawings.

Information



ARCHITECTURAL WORKING DRAWINGS

The term "working drawings" or "construction drawings" refers to a set of drawings for a structure. They include all the drawings necessary for construction of a building. The entire set usually consists of various types of drawings for different purposes.

A typical set of working drawings for a single-family residence might consist of: a floor plan, a foundation plan, elevations, sectional details, and a plot plan.

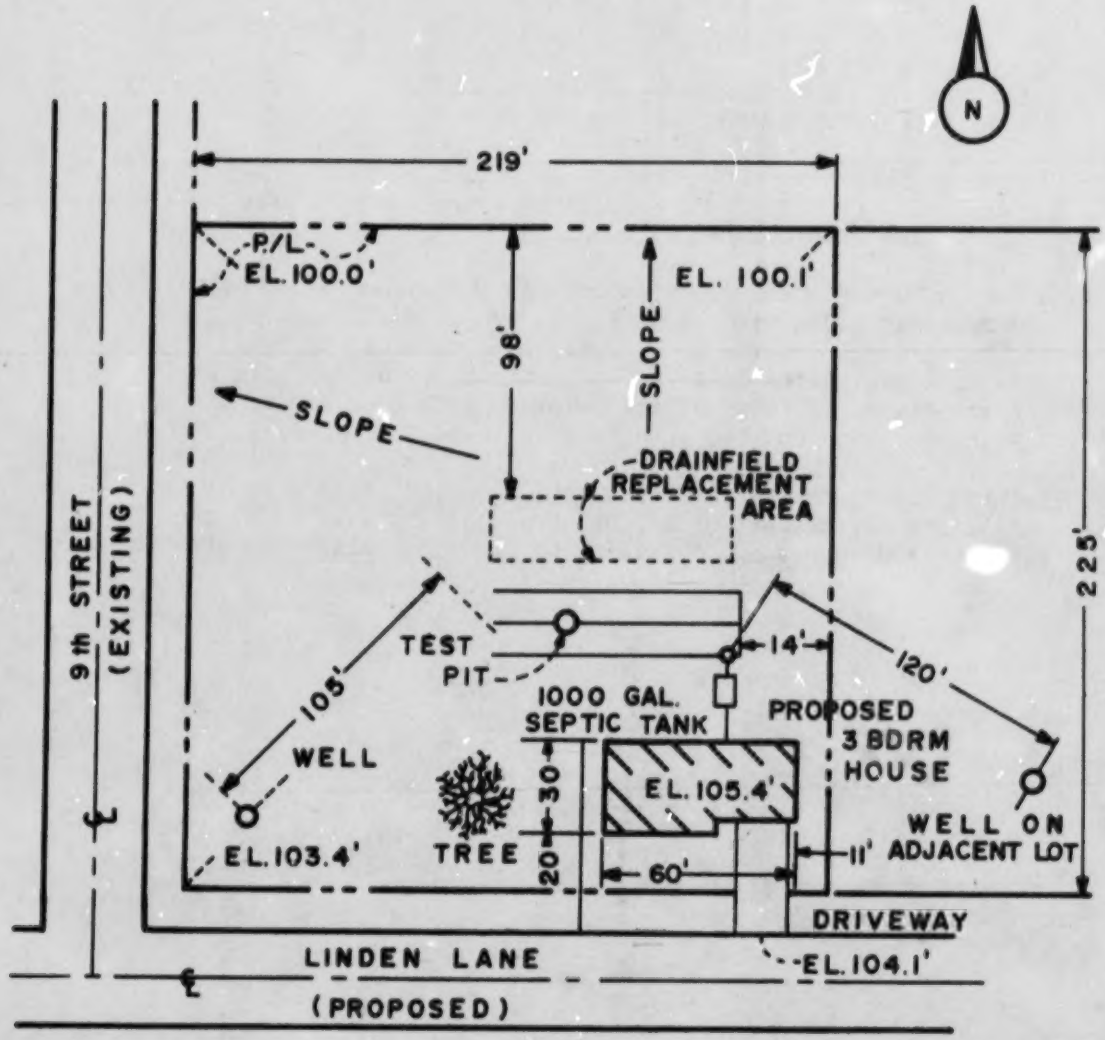
As the structure becomes more complex, the number and complexity of the drawings increases. A small commercial building may have additional drawings for mechanical and electrical systems, or more drawings showing the details for construction of specific parts of the structure. A large office complex might have a many as 100 drawings to show how the structure is to be completed.

In most cases, for small structures, the electrical plan is quite simple and may be part of another drawing. To save time, the electrical plan may be "overlaid" on the floor plan of a structure.

1. PLOT PLAN

An important part of the working drawings for a structure is the plot plan. It describes the property on which the structure will be constructed, the position of the structure on the property, access to the property from streets or roads, existing features of the property and services to the structure.

An example of a plot plan is shown below.

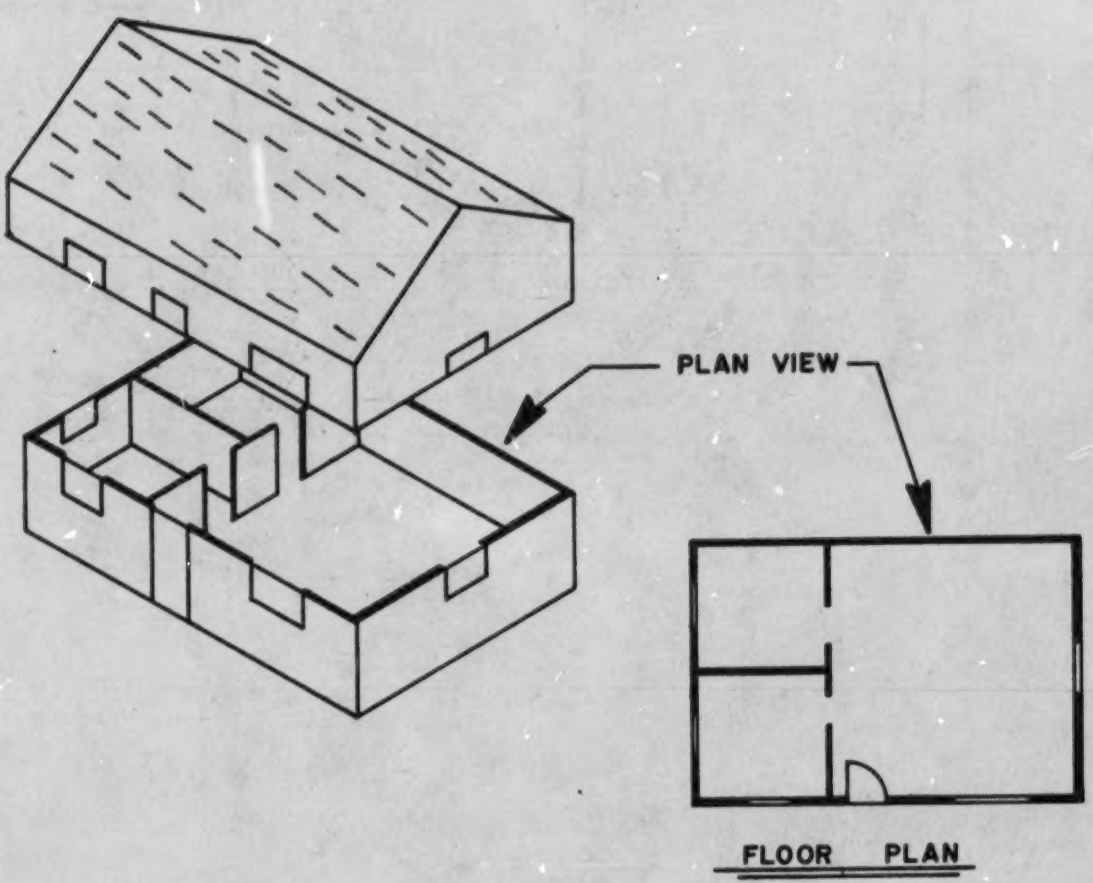


PLOT PLAN

2. FLOOR PLAN

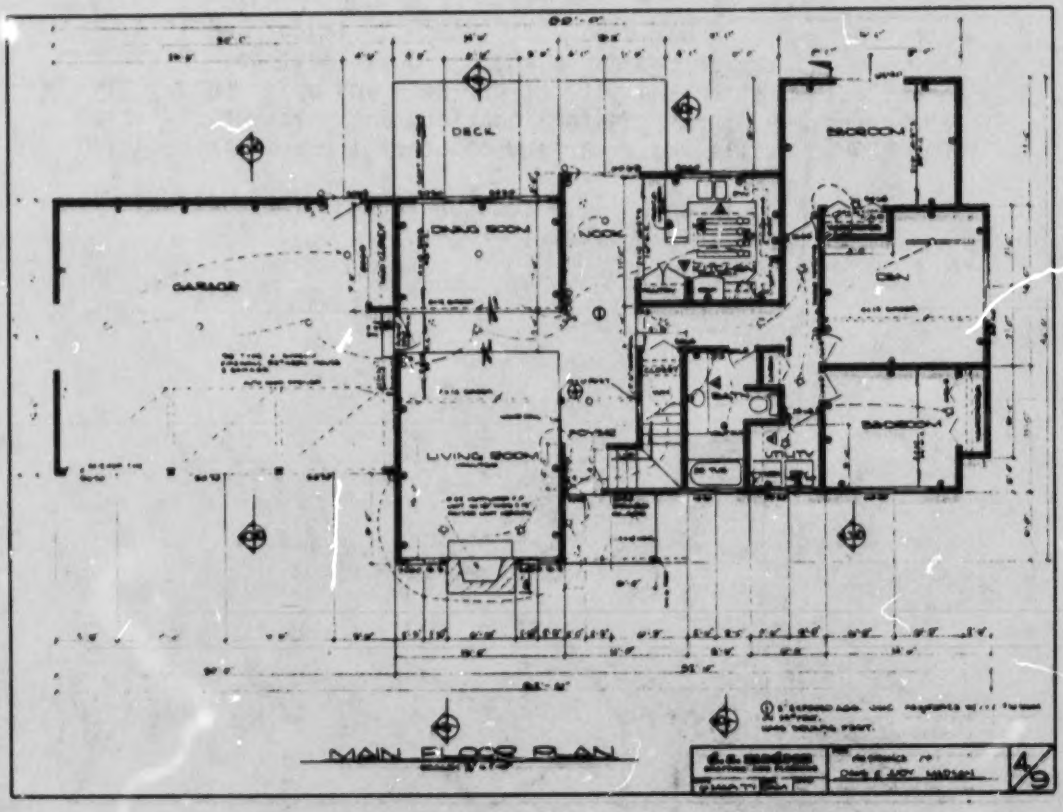
The floor plan contains the information most needed for construction of a building. It shows the layout and sizes of rooms, placement of doors and windows, locations of stairs or steps, location and site of cabinets and appliances. All the necessary dimensions for locations and sizes of partition and bearing walls and a variety of other items of information.

The floor plan is actually a section through the walls of a building, shown in plan view.



FLOOR PLAN

An example of a floor plan is shown below.



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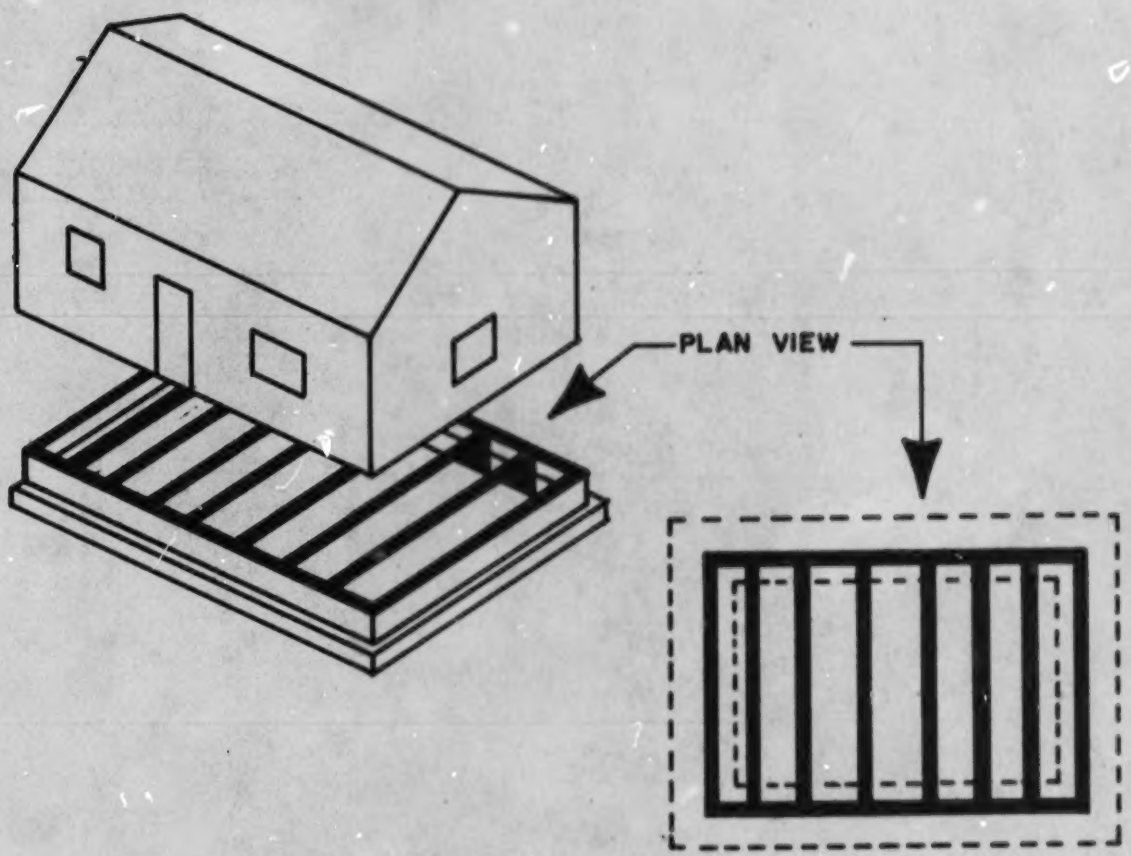
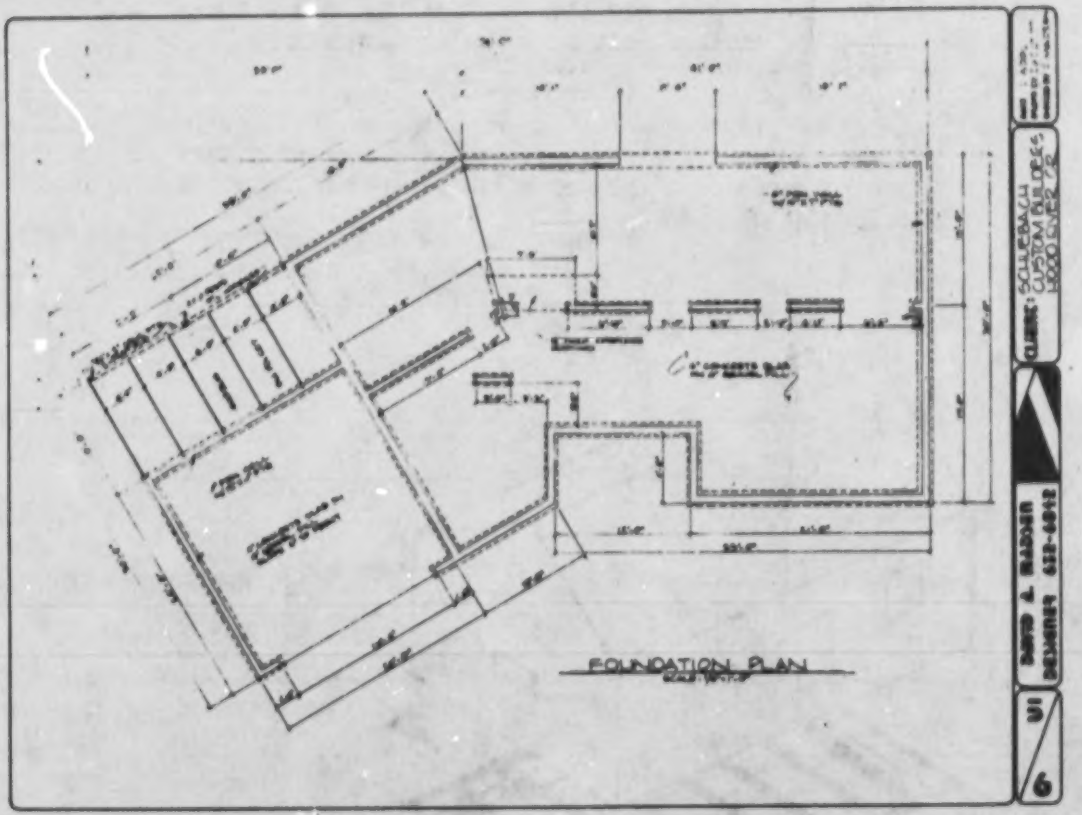
3. FOUNDATION PLAN

The foundation plan may also include the basement plan. It consists of another section shown in plan view. The section is taken just below the first floor.

Foundation plans show the concrete foundation, footings, slabs, girders and posts, air vents, access doors and dimensions for size and location. The mechanical system may also appear on the foundation plan.

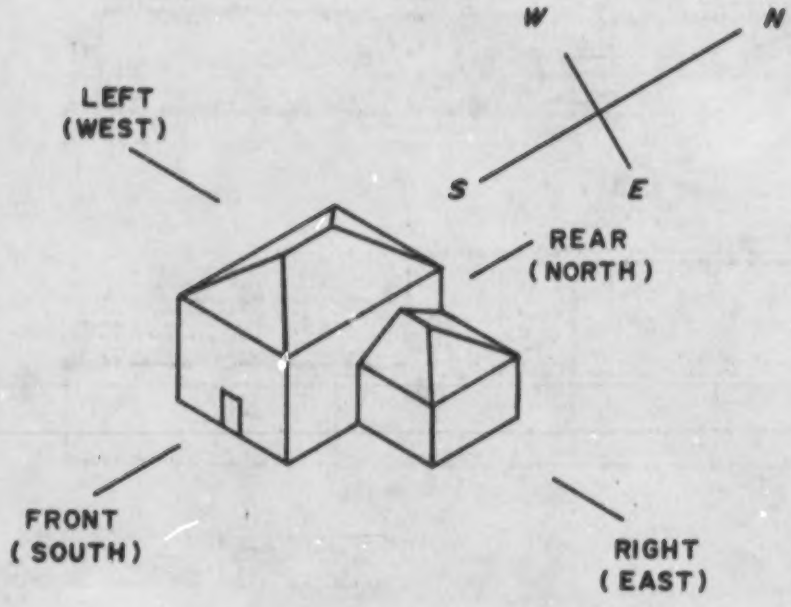


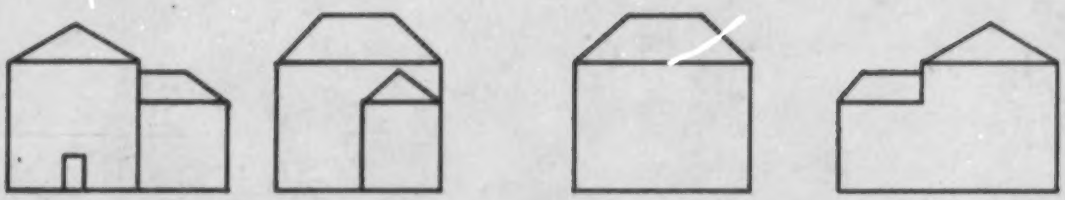
An example of a foundation plan is shown below.



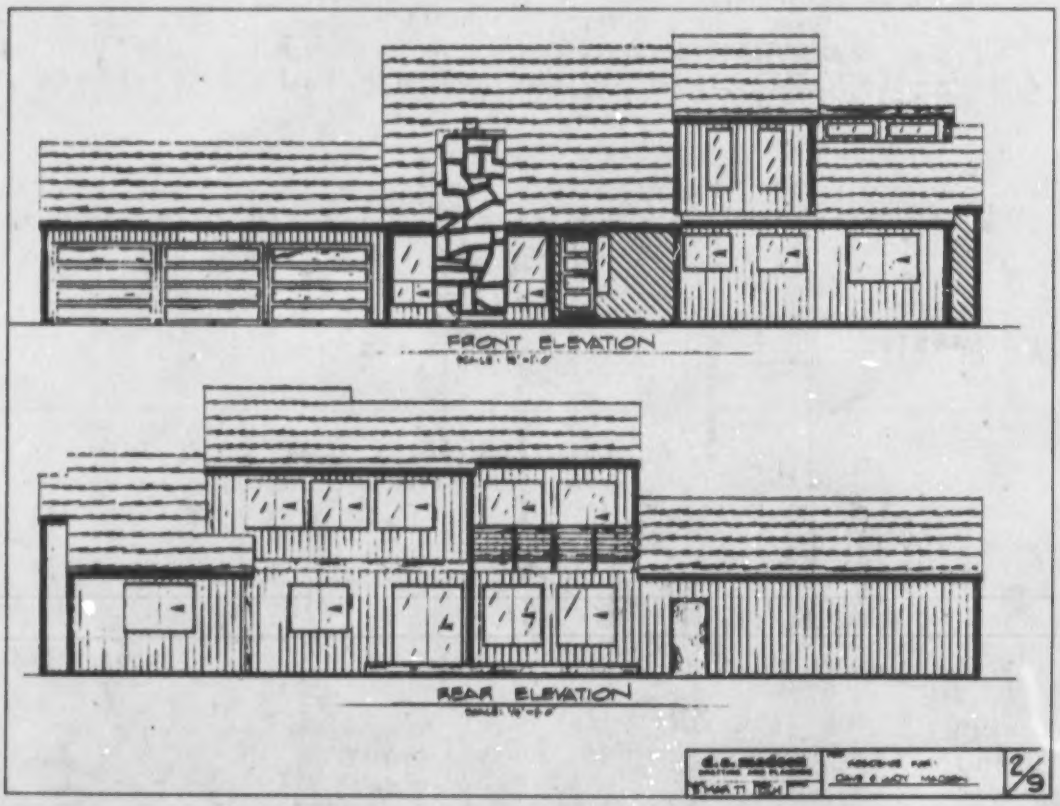
4. ELEVATIONS

Elevations show the exterior sides of the building as they would appear viewed from the front, right side, rear and left side. They may be labeled in this manner or as they would appear looking at the four points of the compass: north, east, south, and west.





An example of a front elevation is shown below.



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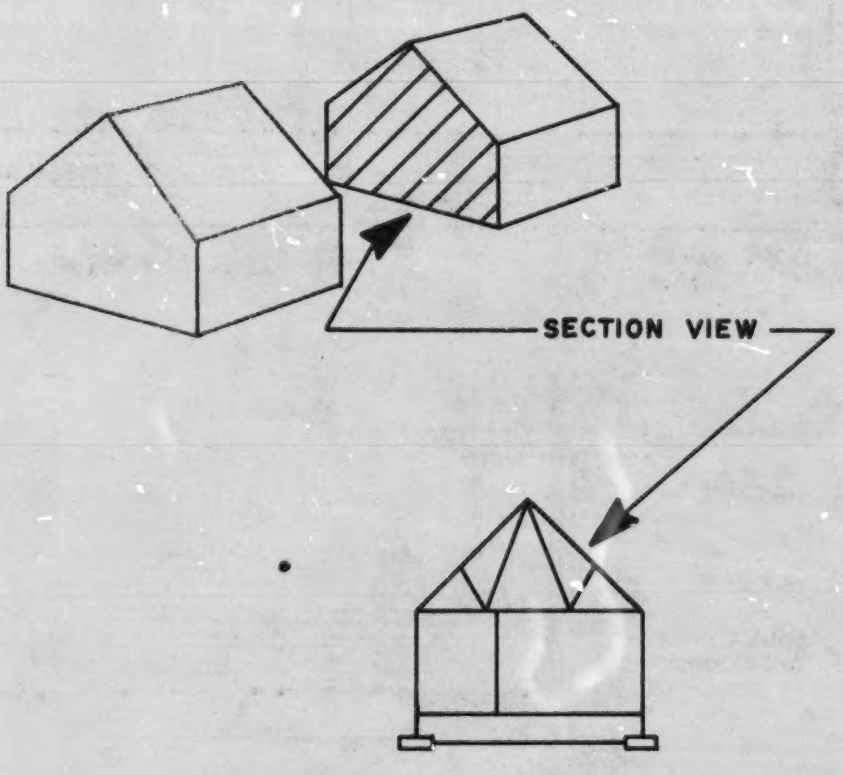
5. DETAILS

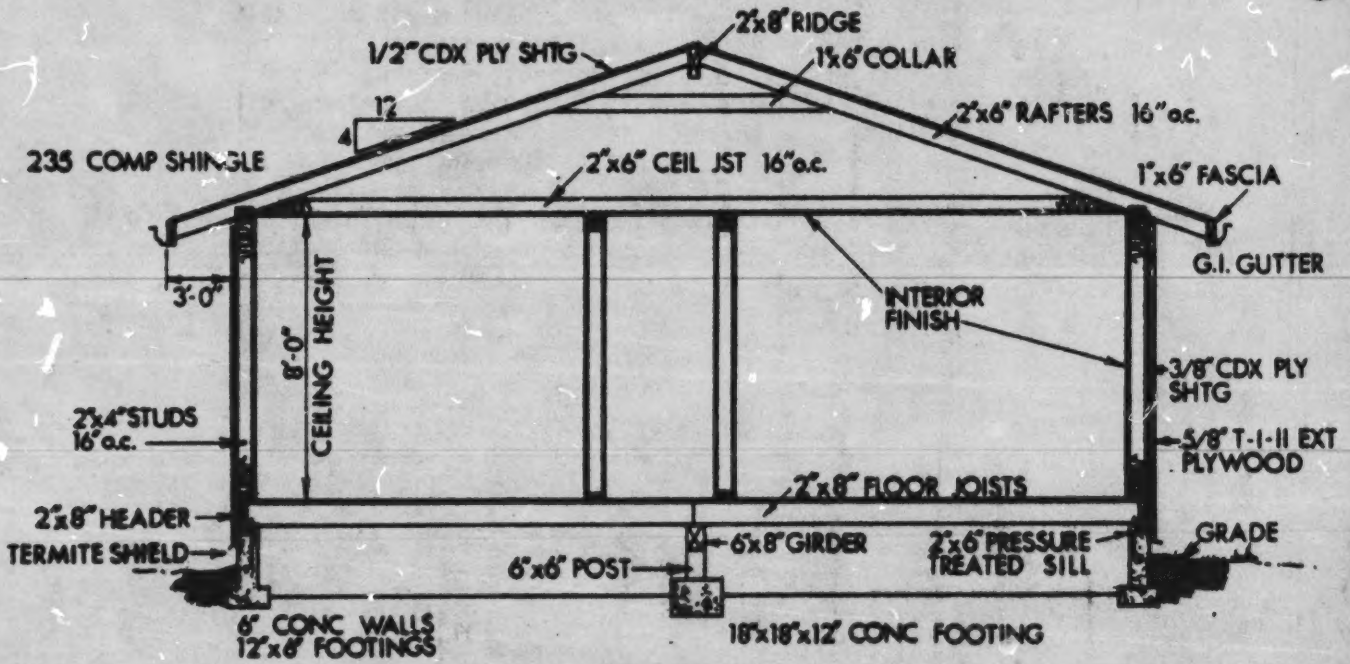
Detail drawings show the particular techniques and materials required to construct various parts of a building. They may include framing details, concrete details, sections, floor framing plans, roof framing plans, beam details, column details or any number of other construction areas which may require more information than is contained on the floor plan.

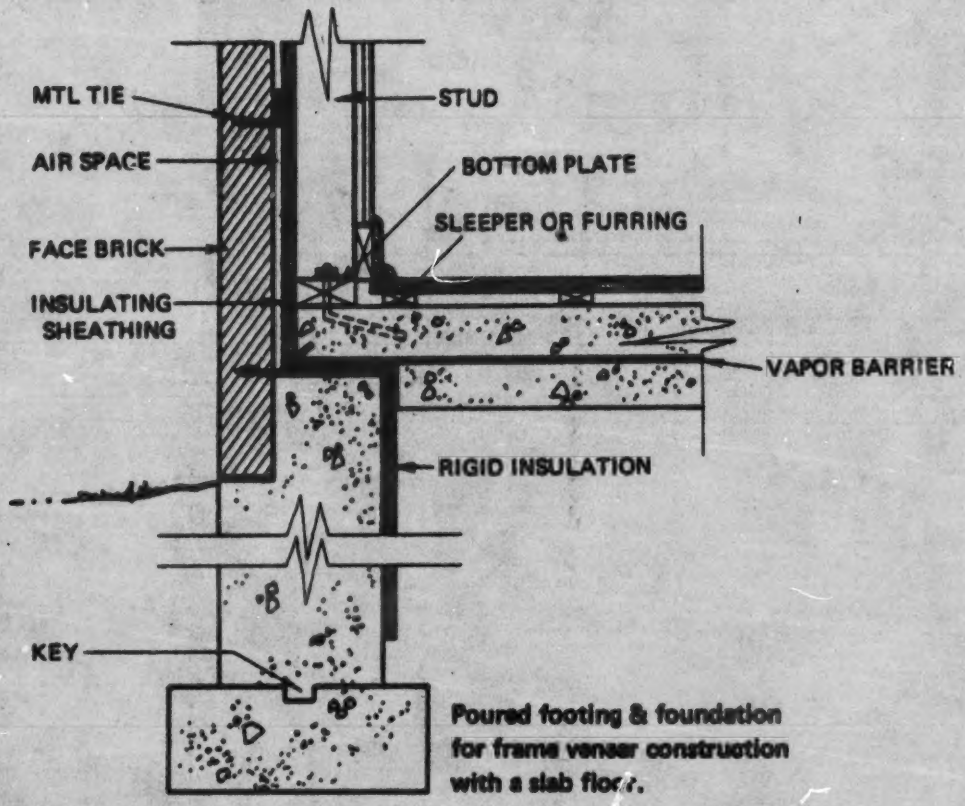
Sections may be taken at any point through the building. They may be full sections, offset sections or broken-out sections.



TYPICAL SECTION

Some examples of common details are shown below.

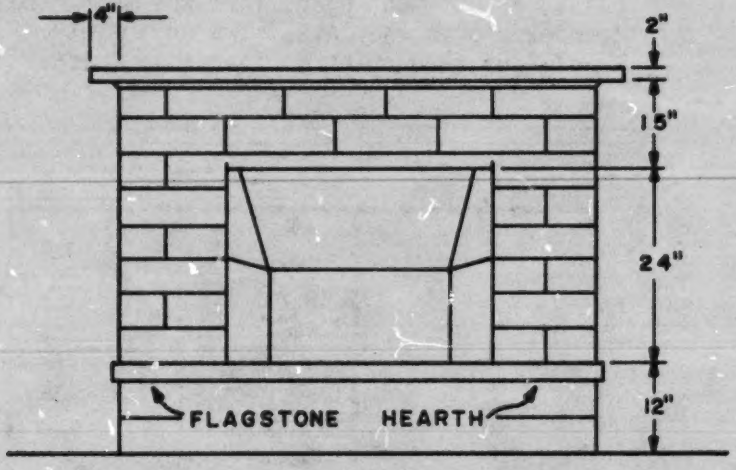




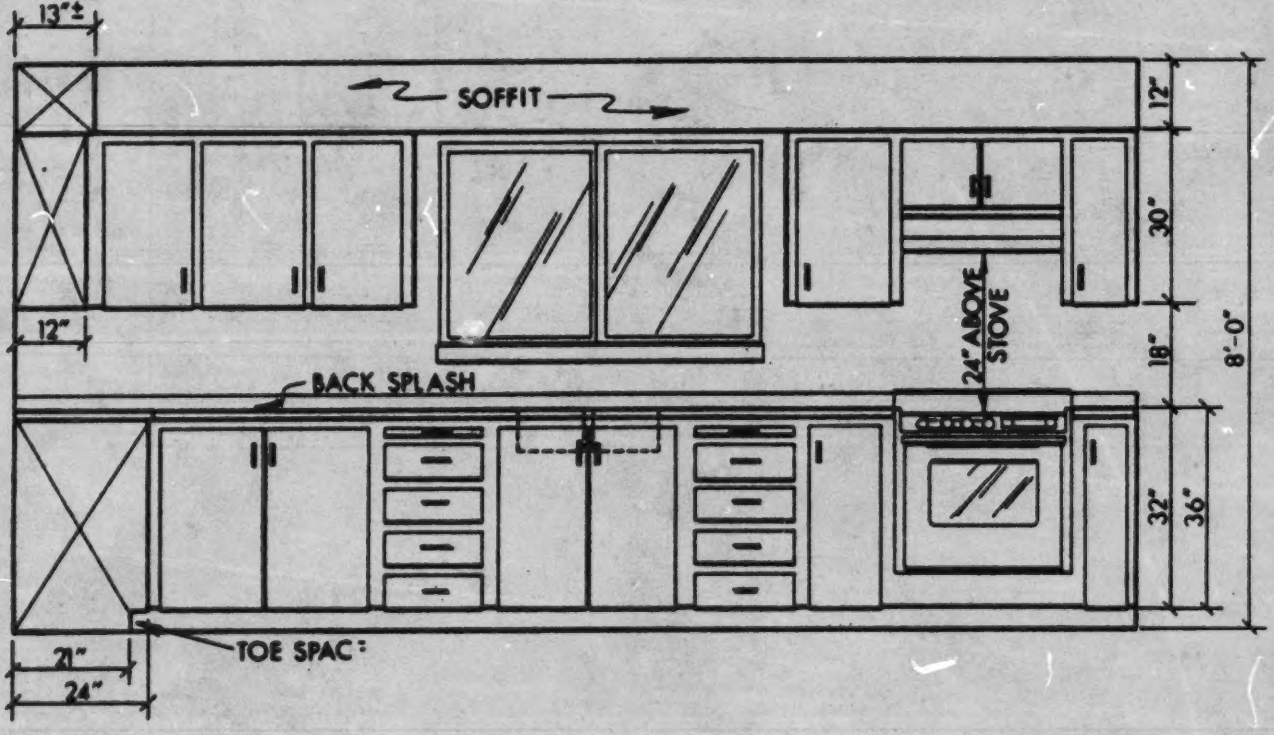
Poured footing & foundation for frame veneer construction with a slab floor.

6. INTERIOR ELEVATIONS

Interior elevations show cabinet walls, fireplaces and special walls as they would appear from inside the rooms. Some examples are shown below.

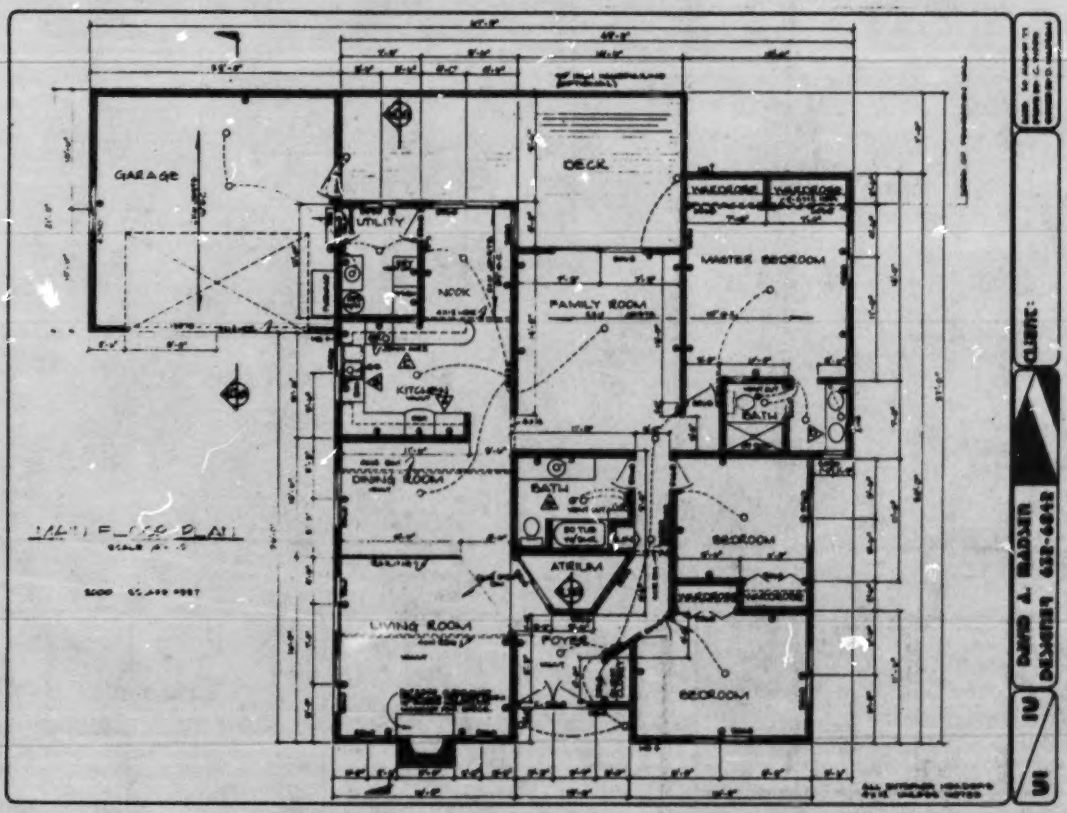


FIREPLACE ELEVATION

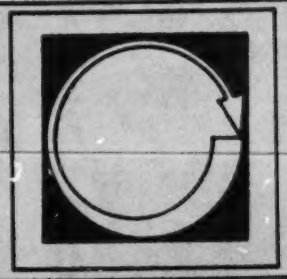


7. MECHANICAL PLANS

Mechanical plans include electrical plans, plumbing plans, and heating, ventilation and air conditioning plans. They may be drawn over (superimposed) on the floor plans, foundation plans, or basement plans. If the mechanical systems become complex enough they are drawn separately or combined on a simplified floor plan or foundation plan.



Self Assessment



Directions: Complete the following sentences.

1. The _____ plan describes the property on which a building will be constructed.

2. The _____ plan shows the layout and sizes of rooms.

3. The _____ plan shows the concrete foundation and concrete slabs.

4. The front _____ shows the exterior of the building as it would appear from the front side.

5. _____ show portions of the building as if they were sliced through.

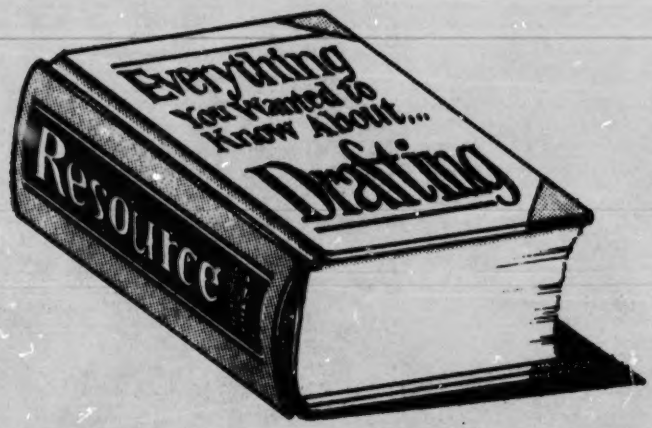
6. _____ eleveations show the inside walls and cabinets in a building.

7. _____ plans show electrical, plumbing, heating, ventilation and air conditioning systems or circuits.

Answers: (1) Plot; (2) Floor; (3) Foundation; (4) Elevation; (5) Section or Details; (6) Interior; (7) Mechanical.

Study Guide

For Further Information:



Contemporary Architectural Drawing, Dagostino, 1977.

Architectural Drawing and Light Construction, Muller, 1967.

ILS Drafting: Architectural, articles 40.00, 40.03, 40.07, 42.05

INSTRUCTIONAL LEARNING SYSTEMS

Drafting

Architectural Symbols & Dimensioning

Floor Plan Symbols
Miscellaneous Symbols
Dimensions

Goal:

The student will be able to interpret symbols used on architectural drawings.

Performance Indicators:

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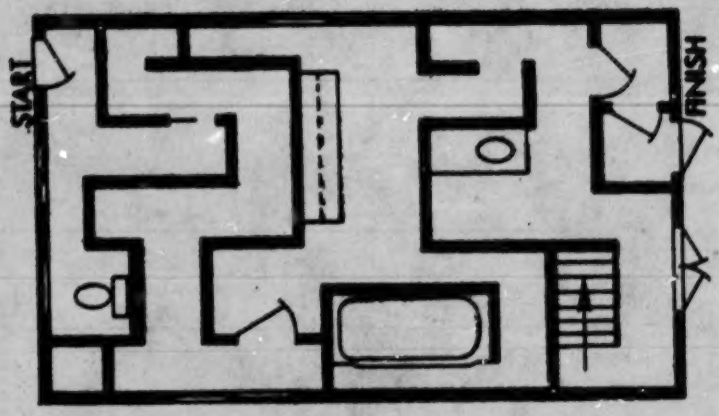
Introduction



Framing members, walls, cabinets, and other features are depicted on architectural drawings by using a series of standard symbols. These symbols help simplify the drawings and increase readability.

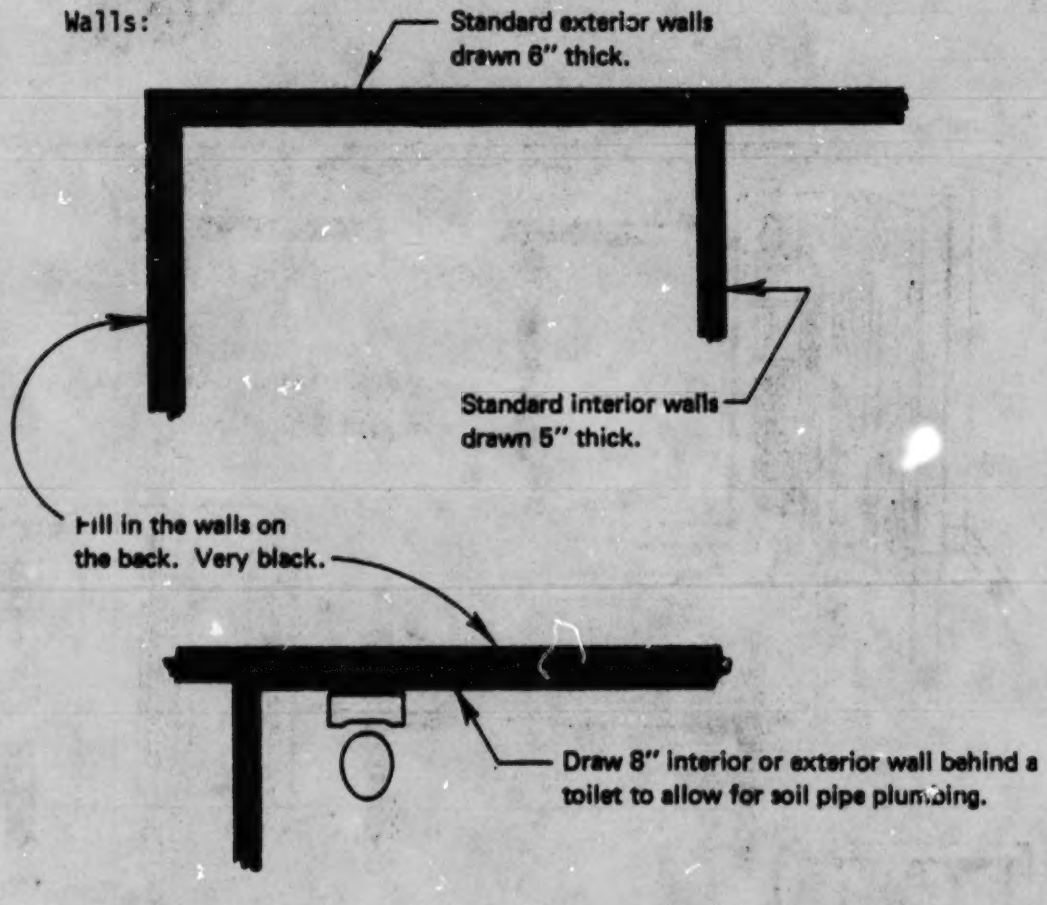
The dimensioning techniques used on architectural drawings differ from those used on mechanical drawings. These differences may be very subtle, but it is important that you understand and recognize them.

Information

1. FLOOR PLAN SYMBOLS

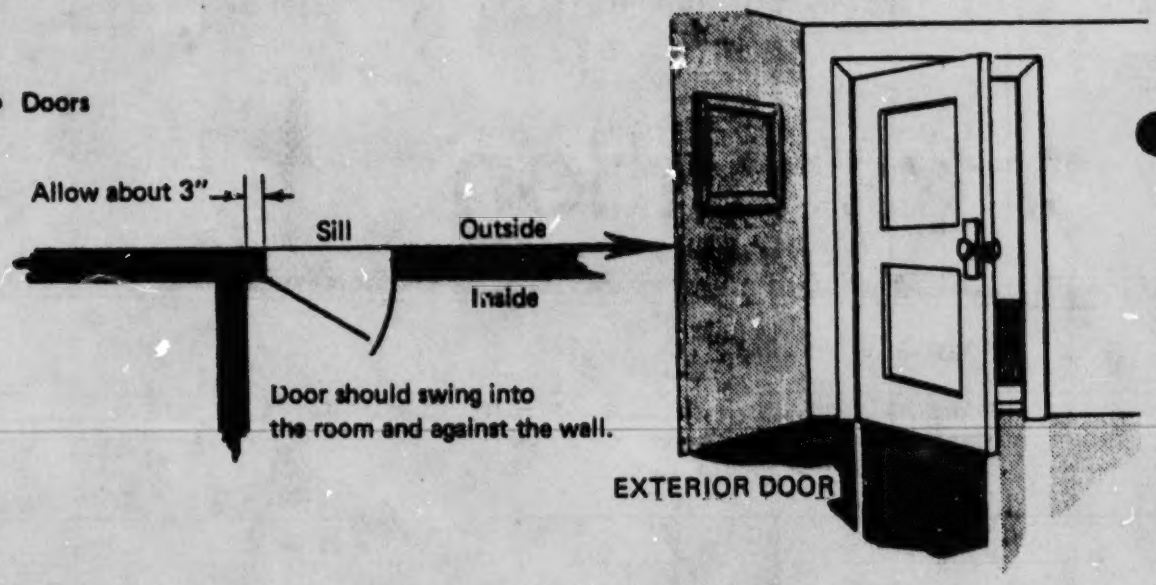
Doors, windows, walls, cabinets, closets and stairs are all shown on the floor plan with symbols. These symbols describe size, type and locations of the features.

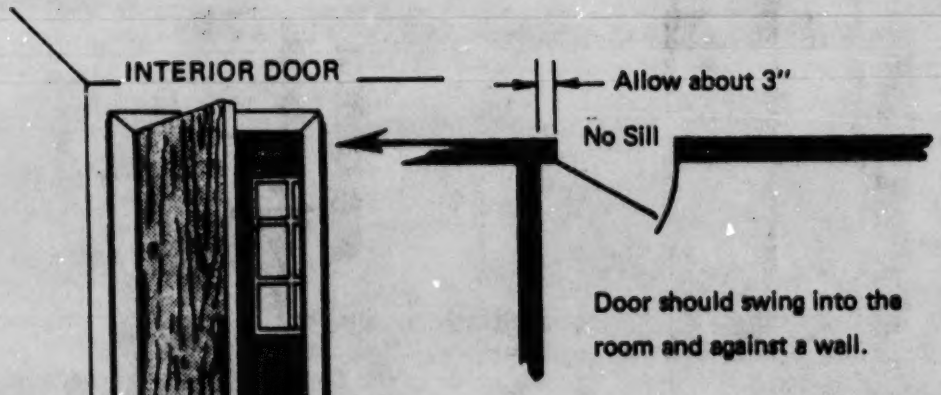
Walls:

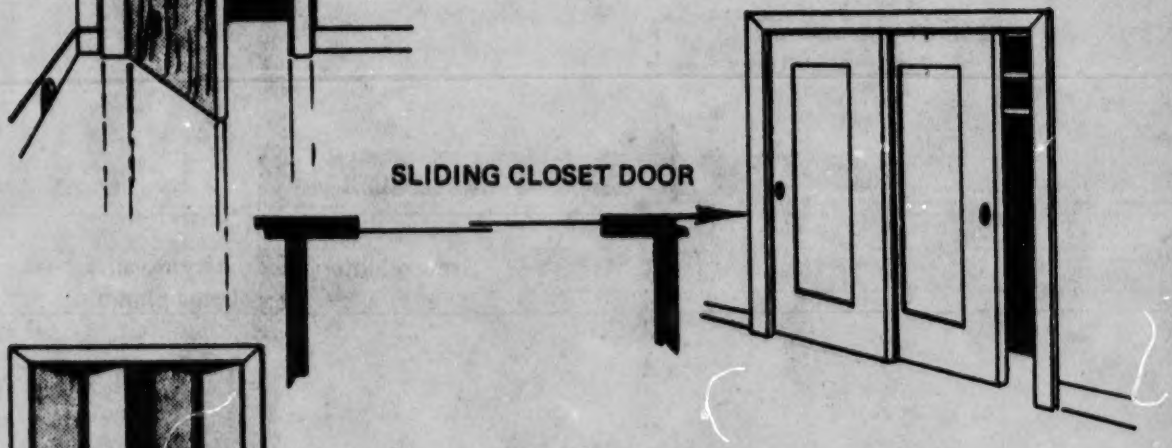

Standard exterior walls drawn 6" thick.
Standard interior walls drawn 5" thick.
Fill in the walls on the back. Very black.
Draw 8" interior or exterior wall behind a toilet to allow for soil pipe plumbing.

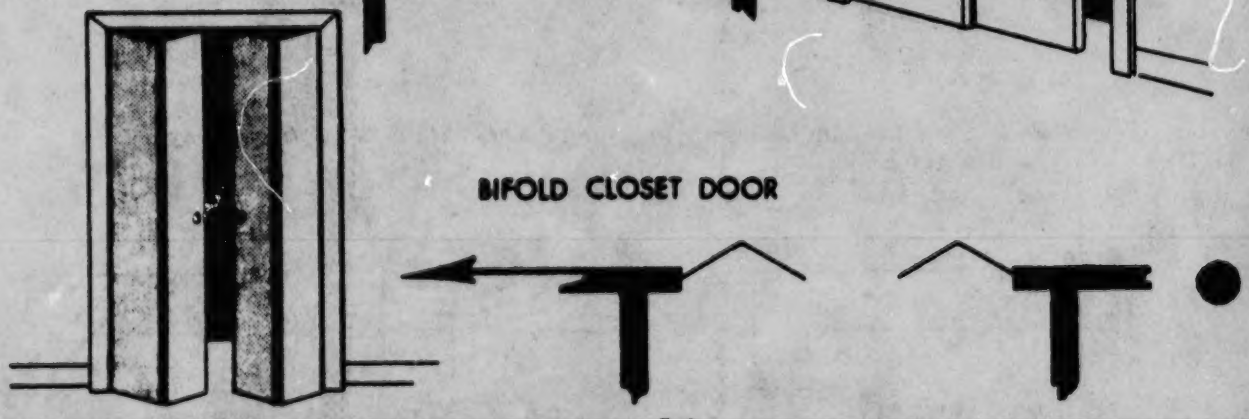
Walls may be blackened in or one of the following symbols may be used.

- Doors


Allow about 3"
Sill
Outside
Inside
Door should swing into the room and against the wall.
EXTERIOR DOOR

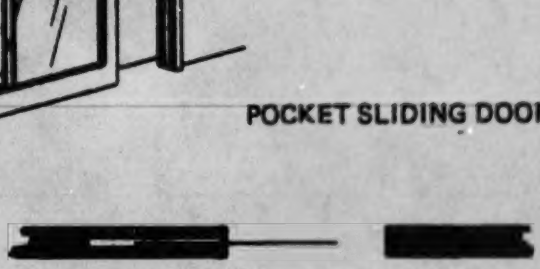

INTERIOR DOOR
Allow about 3"
No Sill
Door should swing into the room and against a wall.

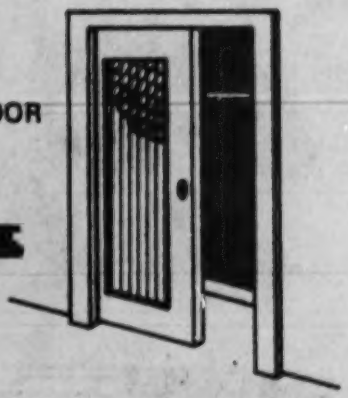

SLIDING CLOSET DOOR


BIFOLD CLOSET DOOR

SLIDING GLASS (PATIO) DOOR

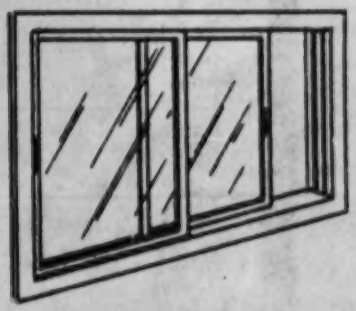
POCKET SLIDING DOOR



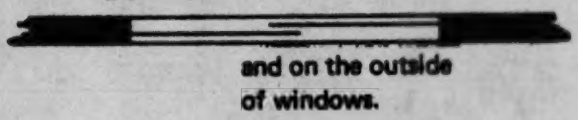


There are many other door symbols, but these are the most common.
If you need others, see your references.

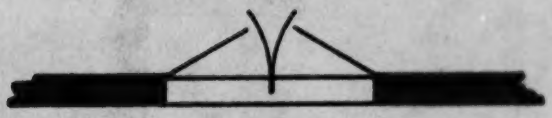
Windows:

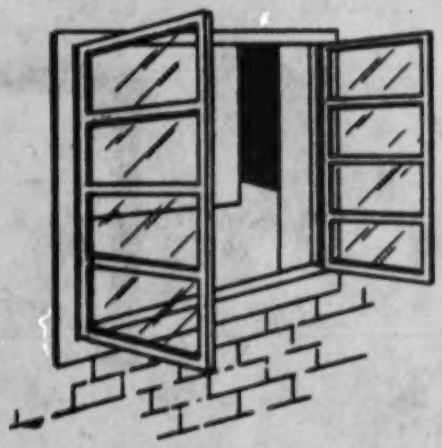


SLIDING WINDOW

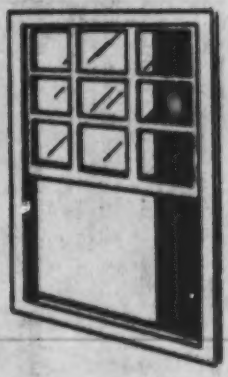


CASEMENT WINDOW

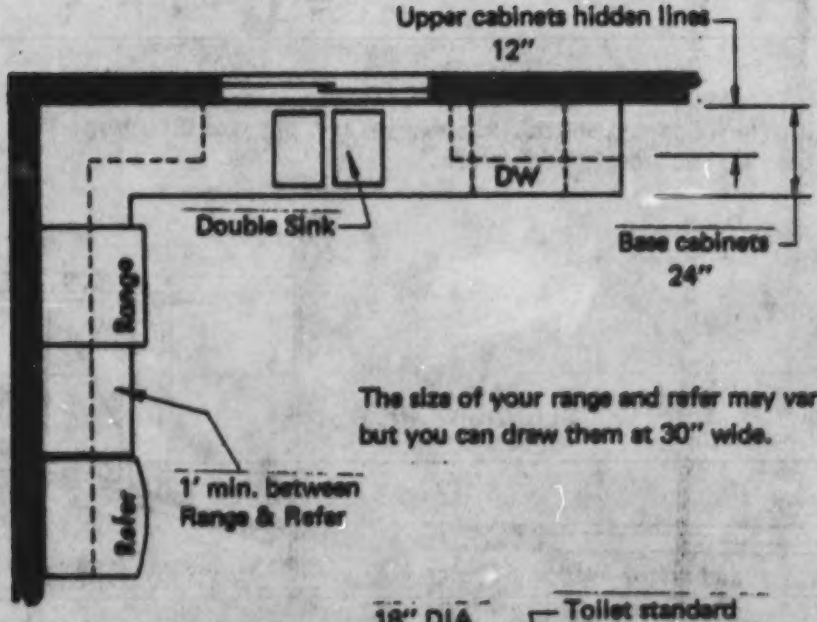


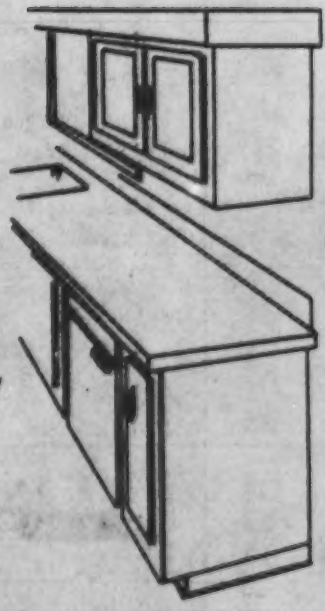


DOUBLE HUNG WINDOW

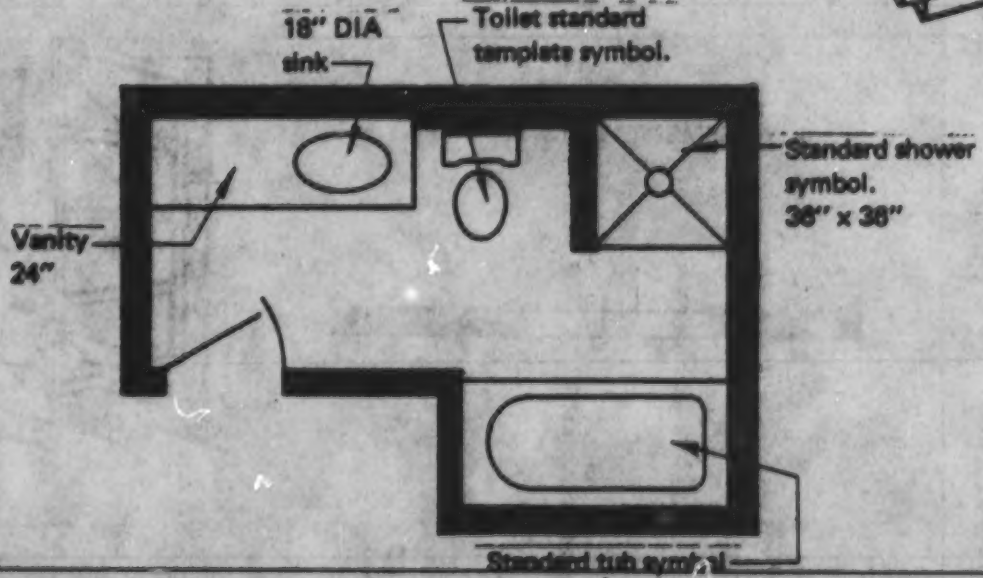


Cabinets & Fixtures:

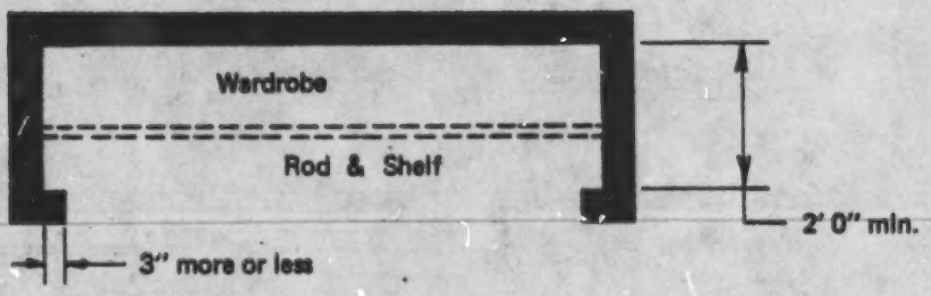




The size of your range and refer may vary but you can draw them at 30" wide.

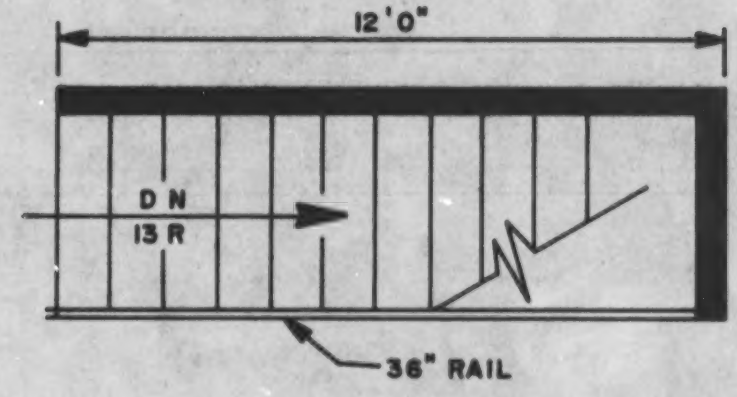


Closets:



A minimum single wall walk-in closet might be 5'0" wide x 5'6" long, and a minimum double wall could be 7'0" wide x 5'6" long.

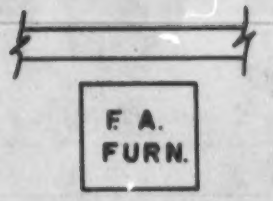
Stairs:



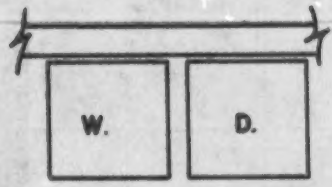
Stairs in plan only show the direction and number of risers and wall lengths.

MISCELLANEOUS SYMBOLS:

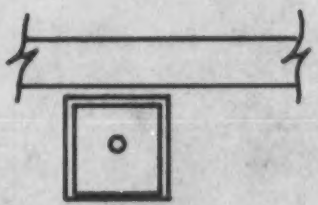
HOT WATER HEATER



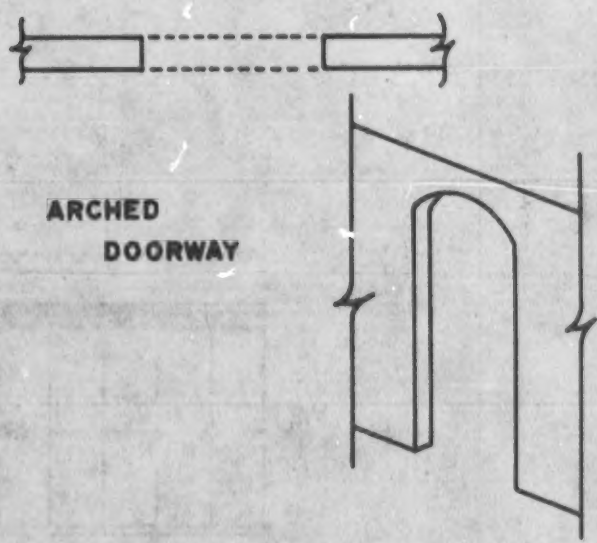
FORCED AIR FURNACE



WASHER & DRYER



LAUNDRY TUB

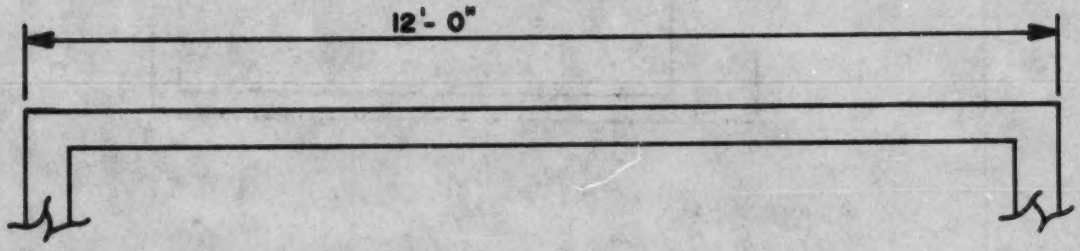


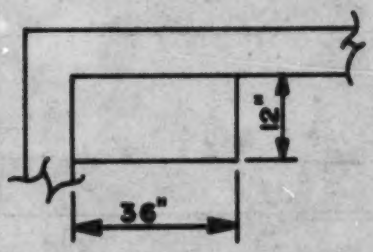
ARCHED DOORWAY

2. DIMENSIONS

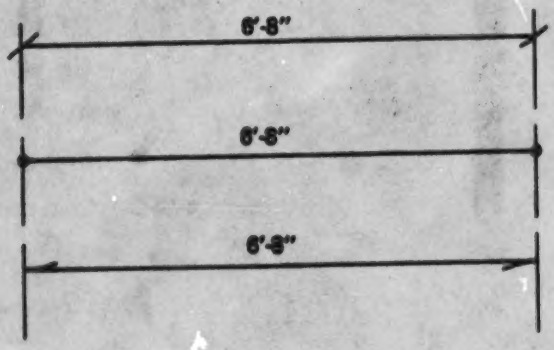
Architectural dimensions are always given in inches for measurements up to six feet and in inches and feet for measurements over six feet.

The dimension line is not broken as it is in mechanical drawing and the dimension is placed above the dimension line.

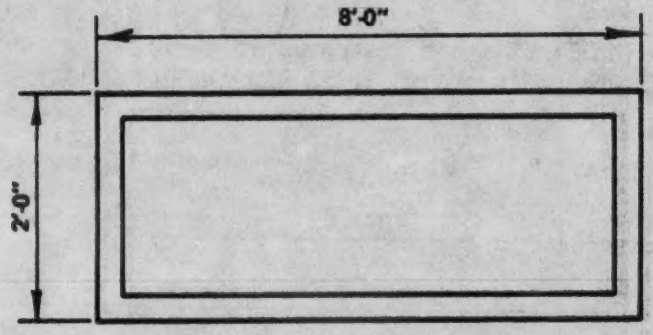




Dimension lines may be capped with arrowheads where they meet the extension lines, or they may be like this:

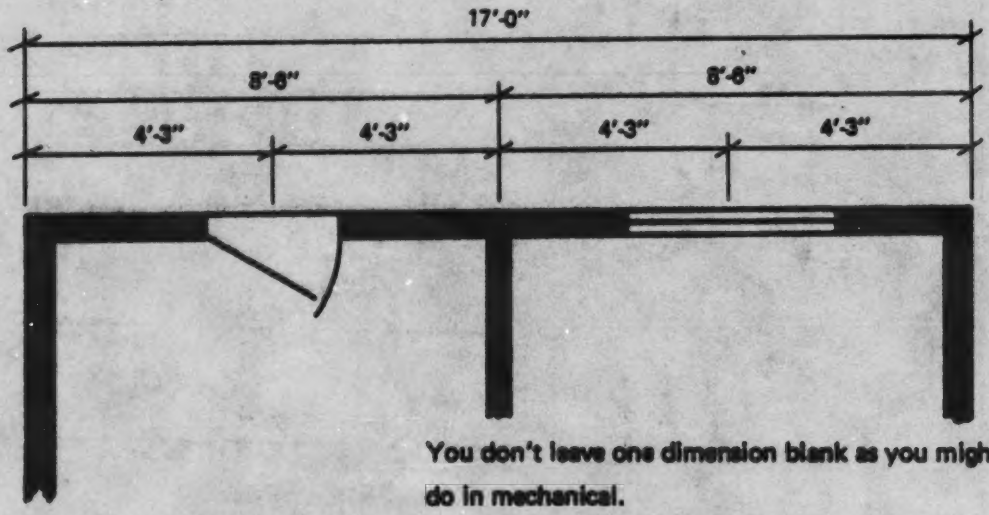


Aligned dimensioning is used so that the dimensions read from the bottom and right side of the sheet.



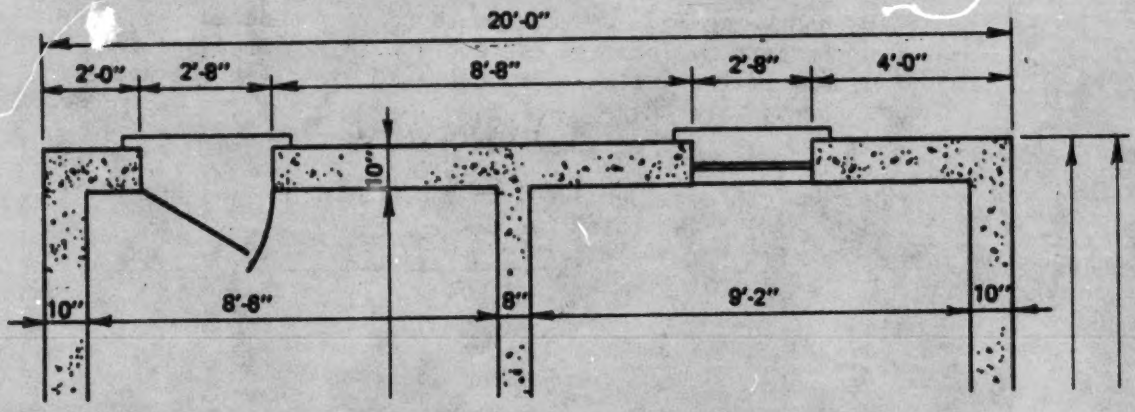
The overall dimensions on frame construction are given to the outside of the stud frame, because that dimension is used first, before the sheathing and other wall covering is applied.

In this wall frame structure, dimensions of interior walls, windows, and doors to the centers.



You don't leave one dimension blank as you might do in mechanical.

When you dimension concrete or masonry construction as in a residential basement, then you can do it like this:



In wood frame, the window and door size determines the size of the opening and may be slightly oversize, but in concrete the size is critical, hence the difference in dimensioning.

3. SCHEDULES

- Schedule Setup

A schedule is a chart of materials or products with size description, quantity, and any other information needed to construct or finish the building.

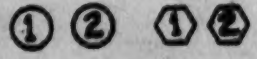
Schedules aid a drawing by keeping the drawing clear of unnecessary notes. Items that can be keyed to the drawing and placed in a schedule, such as windows and doors, should be considered. There are many different ways to set up a schedule; here is a simple example:

DOOR SCHEDULE

Key	Quant	Size	Description
1	2	3'0" x 6'8"	Solid Core
2	6	2'8" x 6'8"	Hollow Core
3	4	6'0" x 6'8"	Bi-Fold Closet
4	2	8'0" x 6'8"	Glass Sliding - Safety
5	1	2'8" x 6'8"	Pocket Sliding

This example gives only the minimum information, others tell material and remarks about the product.

- Schedule Key

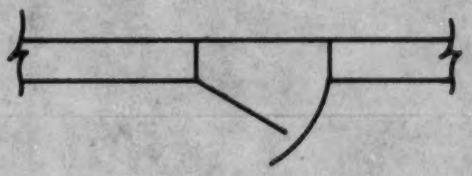
The doors and windows must be keyed to the schedule. This can be done by labeling the doors with a number and the windows with a letter. You can also use different geometric features; like this 

Or, you can consider labeling windows with a (W) and doors with a (D), like this .

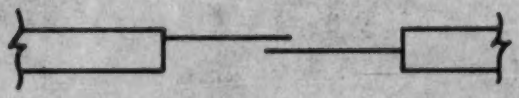
Look at Figure 1.

Self Assessment

Directions: Identify the following symbols:

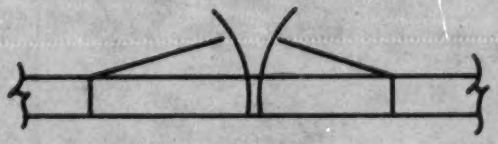
(1)  _____

(2) _____

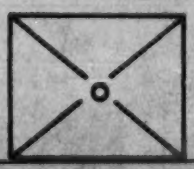
(3)  _____

(4) _____

(5) _____

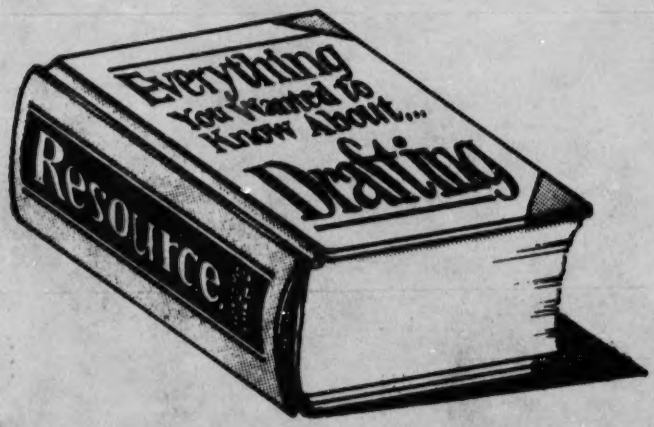
(6)  _____

(7) _____

(8)  _____

Study Guide

For Further Information:



Architecture, Design-Engineering-Drawing, Spence, 1972.

Architectural Drawing and Light Construction, Mueller, 1967.

ILS Drafting: Architectural, articles 40.00, 40.02, 40.03

Drafting

Basic Architectural Electrical Symbols

Lighting Symbols
Switch Symbols
Electrical Outlets or Receptacles
Basic Switch Arrangements
Miscellaneous Symbols
Abbreviations

Goal:

The student will be able to identify basic symbols used in electrical drawings.

Performance Indicators:

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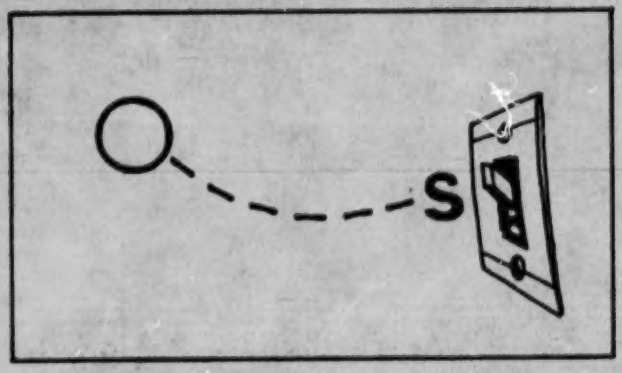
Introduction



Since most electrical plans are those used with architectural-type drawings, the main emphasis will be on symbols used in this type of electrical plan.

Unlike the symbols used in most electronic schematic diagrams, the symbols for architectural drawings describe a total piece of hardware or a unit of electrical components. Most of the symbols are simple; for example, circles or squares, with an identifying letter or letters to help distinguish one symbol from the next.

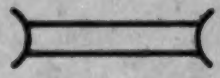
The exact purpose of the drawing will determine the type of drawing used. Several types of electrical drawings will be discussed in subsequent modules. However, the symbols will remain relatively unchanged from one type of drawing to another.

Information

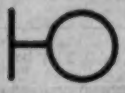
1. LIGHTING SYMBOLS

There are two common types of lighting fixtures used in most structures. The incandescent and fluorescent lamp are the most frequently used fixtures in most residences and light commercial buildings. The basic symbols are shown below.

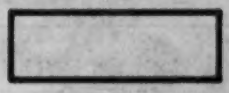
INCANDESCENT LAMP CEILING MOUNTED



FLUORSCENT STRIP

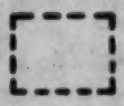


INCANDESCENT LAMP WALL MOUNTED



FLUORESCENT FIXTURE

A light fixture that is recessed in the ceiling would have a dashed line indicating the basic shape of the fixture, for example:



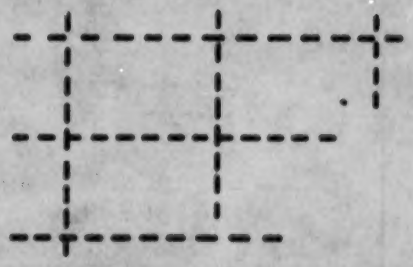
RECESSED INCANDESCENT LAMP

RECESSED FLUORESCENT LAMP

Some of the other lighting symbols are shown below.

WALL MOUNTED LAMP W/PULL SWITCH

CEILING MOUNTED LAMP W/PULL SWITCH



SUSPENDED, LIGHTED CEILING PANELS

2. SWITCH SYMBOLS

The basic switch symbol for a typical lighting circuit is merely the letter "S" placed on the plan in the position where the switch is to be located. Switches that control more than one circuit or that work in conjunction with other switches are indicated by the number "3" or "4" placed by the letter "S."

S	S_3	S_4
BASIC SWITCH SYMBOL	THREE - WAY SWITCH	FOUR - WAY SWITCH

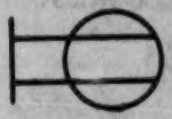
Some of the other switch symbols:

S_P	S_T
SWITCH WITH A PILOT LIGHT	TOGGLE SWITCH WITH THERMAL CIRCUIT PROTECTOR (FUSED)

Other identification letters may be used with a table or legend to indicate their meanings.

3. ELECTRICAL OUTLETS OR RECEPTACLES

The basic electrical outlet with two receptacles is known as a duplex receptacle. The symbol is shown below.



DUPLEX RECEPTACLE

Modifications to the basic duplex receptacle symbol include those for waterproof outlets, switch and receptacle combinations and receptacles with one outlet controlled by a switch.

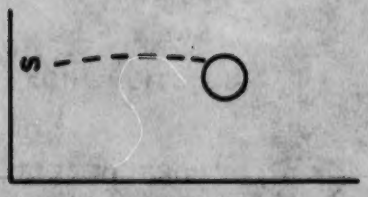
WEATHERPROOF

COMBINATION

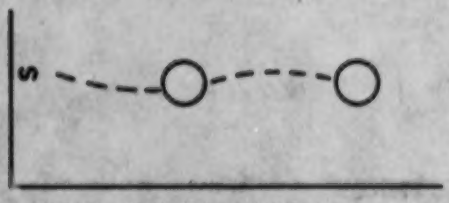
WITH SWITCH

4. BASIC SWITCHING ARRANGEMENTS

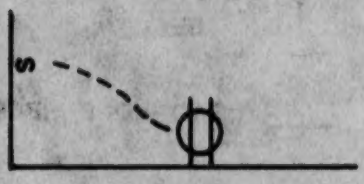
A dashed line from the switch to the receptacle or lamp fixture indicates the basic wiring for these fixtures.



SINGLE SWITCH
AND LAMP



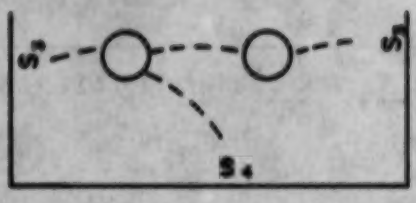
SINGLE SWITCH AND
TWO LAMPS



SWITCH AND RECEPTACLE

SWITCH AND WALL MOUNTED
LAMP

TWO THREE-WAY SWITCHES
AND A SINGLE LAMP



TWO LAMPS CONTROLLED
BY THREE SWITCHES

5. MISCELLANEOUS SYMBOLS

There are many other symbols used on electrical plans. A few are shown below.

RECEPTACLE, MOUNTED FLUSH WITH FLOOR

DOOR BELL OR CHIME PUSH BUTTON

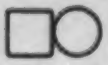
BUZZER

JUNCTION BOX

POWER OR LIGHT PANEL

SMOKE DETECTOR

SPECIAL OUTLET (IDENTIFY WITH LETTERS)


BELL

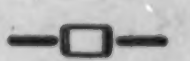
TELEPHONE OUTLET

240 VOLT RECEPTACLE

MOTOR CONNECTION

FAN CONNECTION

CIRCUIT BREAKER


FUSE

6. ABBREVIATIONS

CB - Circuit Breaker
AFF - Above Finished Floor
CSP - Central Switch Panel
MDP - Main Distribution Panel
Gd - Grounded
NL - Night Light
R - Recessed
WP - Waterproof
M - Motor
F - Fan
TEL - Telephone
BUS - Busway
COND - Conduit
CRCT - Circuit
FDR - Feeder
FLUOR - Fluorescent
KW - Kilowatt
PL - Pilot Light

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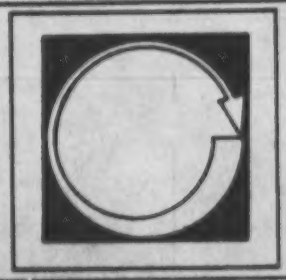
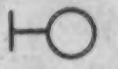
Self Assessment

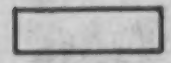


Directions: Identify the following symbols. Place your answers in the space provided. Check your answers with those on page 43.

(1)

(2) 

(3)

(4) 

(5)

(6)

(7) S

(8) S_3

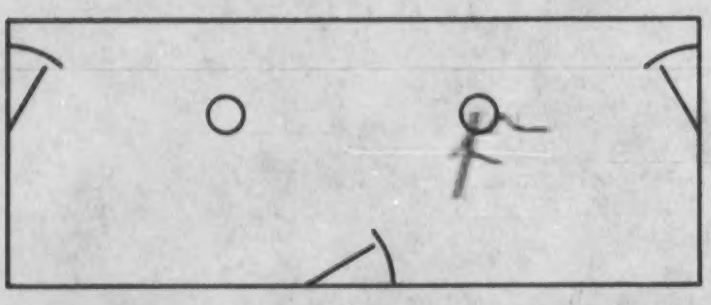
(9)

(10)

(11)

(12)

Directions: Sketch the switch arrangement for two ceiling mounted lamps controlled by three switches.

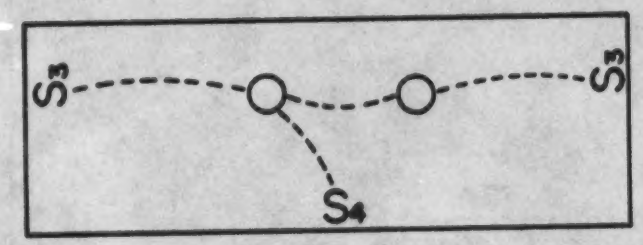


40

Answers to Self Test

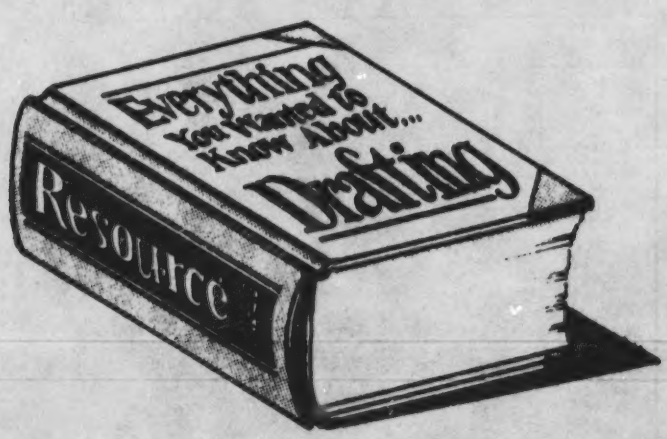
(1) Fluorescent Strip; (2) Wall Mounted Lamp; (3) Ceiling Mounted Lamp; (4) Fluorescent Fixture; (5) Recessed Fixture; (6) Wall Mounted Lamp w/Pull Switch; (7) Switch; (8) Three-Way Switch; (9) Duplex Receptacle; (10) Waterproof receptacle; (11) Floor Mounted Receptacle; (12) Junction Box;

(13)



Study Guide

For Further Information:



IEEE Standard and American National Standard, Graphic Symbols for Electrical and Electronic Diagrams, 1971, ANSI V32.2.

Electrical and Electronics Drawings, Baer, 1973.

National Electrical Code, 1975 ed.

National Electrical Code Blueprint Reading, Gibert, 1974.

Electrical Blueprint Reading, Traister, 1975.

Electrical Trades Blueprint Reading, Vol. 1-3, Delmar Publish., 1961.

ILS Drafting: Electrical/Electronic, article 26.00

INSTRUCTIONAL LEARNING SYSTEMS

Drafting

Wiring Symbols

Switches, Contacts & Relays
Circuit Protectors
Conductors
Power Distribution Symbols

Goal:

The student will be able to identify symbols used in electrical wiring diagrams and riser diagrams.

Performance Indicators:

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Introduction

All electrical diagrams use symbols to indicate components, contacts and switches. These symbols simplify the diagrams and provide an expeditious means of showing electrical components.

Standards for symbols have been established by the American National Standards Institute. Those standards are reflected in this module.

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Information

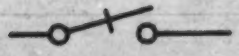
1. SWITCHES, CONTACTS AND RELAYS

Electrical wiring diagrams usually contain several switches or switching assemblies. The symbols used in single-line wiring diagrams show each switch and contact in relation to the circuit it controls. The basic switch symbols are shown below.

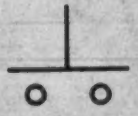
SINGLE-THROW SWITCH

DOUBLE-THROW SWITCH

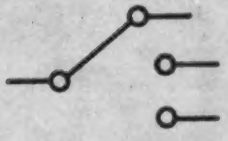
DOUBLE-POLE DOUBLE-THROW SWITCH



KNIFE SWITCH



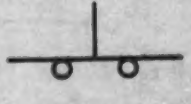
PUSH BUTTON SWITCH



SELECTOR SWITCH

The switches shown above, with the exception of the selector switch, are shown in an "open" position. In each case, the switch is "closed" if the symbols are touching, for example:

SINGLE-THROW (CLOSED)



PUSH BUTTON (CLOSED)

As you can see in the switch symbols, the contact is the open-circle portion of the symbol.

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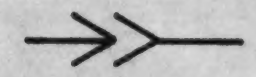
Disconnection type couplings, such as plugs and jacks, have a special symbol which indicates how the connection is made.

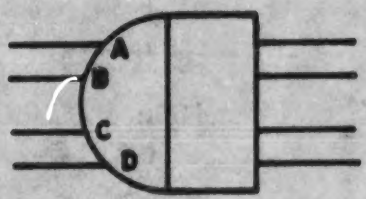
Together, these symbols indicate a separable connector.



When used in multiples, the symbols indicate several plugs and jacks in one piece of hardware.

The letters are added for identification.

Another symbol that indicates a multiple connection device is shown below.



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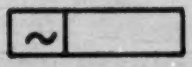
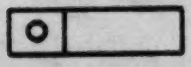
Relays are shown as a square with the letter "R" inside or as a rectangle with an identifying symbol on one end.

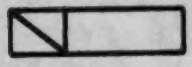
Other letters may be used to identify special characteristics of the relay:

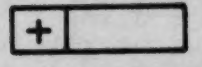
AC - alternate current
D - differential
DB - double biased
EP - electrically polarized
FO - fast operate
FR - fast release
P - mangetically polarized
SO - slow operate
SR - slow release

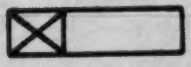
Specific relay symbols:

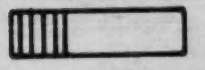

Alternate current


Fast operate


Fast release


Magnetically polarized


Slow operate


Slow release

2. CIRCUIT PROTECTORS

Circuit protectors are normally fuses or circuit breakers of various types. The basic symbols are shown below.

CIRCUIT BREAKER

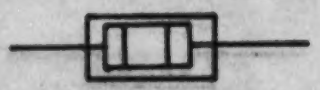
FUSES

Note: Sometimes the symbol for a thermal element is used to indicate a thermal-overload fuse.

THERMAL ELEMENT

Some of the modified symbols are:

HIGH-VOLTAGE FUSE



OIL-TYPE HIGH-VOLTAGE FUSE

3. CONDUCTORS

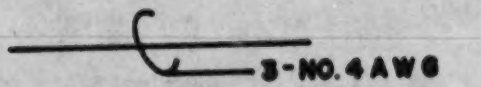
Electrical transmission paths are shown in a variety of ways, depending on the type of drawing in which they are used.

Single-line drawings use symbols that would indicate one, two, three or more conductors or wires. Qualifying letters may be used to indicate special characteristics of the conductor or wire sites.

BASIC CONDUCTOR SYMBOL

CONDUCTOR SYMBOL FOR POWER

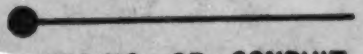
Conductor symbol for architectural drawings (shows only circuit control and does not indicate actual path of conductor).



Conductor symbol with a note indicating three wires, size no. 4 (American Wire Gage), in a 1 1/2 inch diameter conduit.

In very complex electrical drawings, it may be necessary to indicate the direction of a conduit or conductor turned. This helps trace circuits.

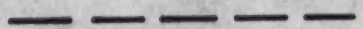
WIRING OR CONDUIT TURNED UP



WIRING OR CONDUIT TURNED DOWN

It may be necessary to indicate whether a conductor is concealed or exposed. The symbols below show how this is indicated.

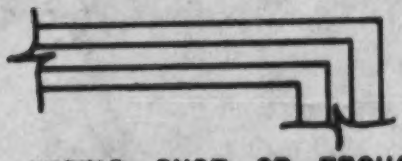
WIRING CONCEALED IN CEILING OR WALL



WIRING CONCEALED IN FLOOR

WIRING EXPOSED

In some drawings, conductors are placed in ducts or "busways." The symbols may vary slightly; but, generally they look like those below.



WIRING DUCT OR TROUGH

WIRING DUCT OR BUSWAY

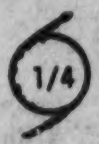
4. POWER DISTRIBUTION SYMBOLS

Because of the simplicity of some electrical diagrams, it is not necessary to show detailed symbols of each electrical component. Therefore, the symbols are simplified to squares or rectangles with letters to describe the electrical part. These parts are referred to as circuit elements. Some of these symbols are shown below.

CB	Circuit Breaker	RG	Recording Unit
R	Relay	DIAL	Dial Telephone
PE	Photoelectric Cell	TTY	Teletypewriter
FL	Filter	AR	Amplifier
PS	Power Supply	MIC	Microphone
T	Transformer	LS	Loudspeaker

Motor and generators are also simplified symbols.

Motor



Motor w/ horsepower indicated

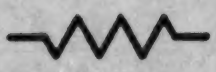
Generator

Metering devices are circles with designation letters inside the circle.

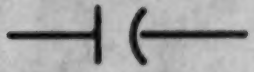
A	Ammeter	OP	Oil Pressure	W	Watt Meter
DB	Decibel Meter	PH	Phase Meter	WH	Watt-hour Meter
F	Frequency Meter	T	Temperature		
OHM	Ohmmeter	V	Volt Meter		

50

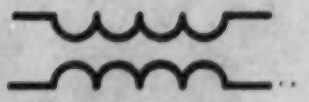
A few symbols remain independent of the drawing type. They are the same for all electrical and electronic wiring diagrams. These symbols are shown below.



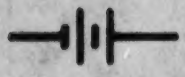
RESISTOR



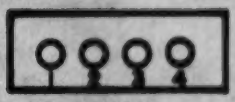
CAPACITOR



TRANSFORMER



BATTERY

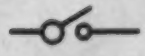


TERMINAL BOARD

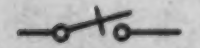
GROUND

Self Assessment

Directions: Identify the following electrical symbols in the space provided. Check your answers with those on the next page.

(1) 

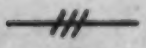
(2)

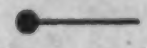
(3) 

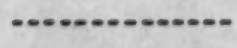
(4)

(5)

(6)

(7) 

(8) 

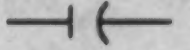
(9) 

(10)

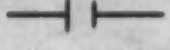
(11)

(12)

(13)

(14) 

(15)

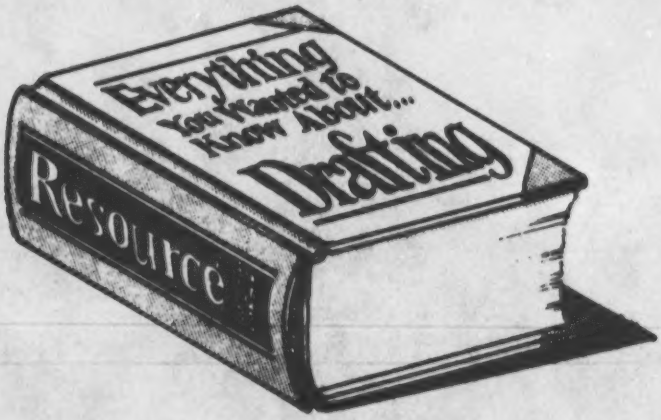
(16) 

Answers to Self Test

(1) Single-throw switch
(2) Push-button switch
(3) Knife switch
(4) Relay
(5) Circuit breaker
(6) Fuse
(7) Three-wire conductor
(8) Wiring turned down
(9) Exposed conductor
(10) Power supply
(11) 1/2 Horsepower motor
(12) Volt meter
(13) Resistor
(14) Capacitor
(15) Transformer
(16) Battery

Study Guide

For Further Information:



IEEE Standard and American National Standard, Graphic Symbols for Electrical and Electronic Diagrams, 1971, ANSI V32.2.

Electrical and Electronics Drawings, Baer, 1973.

National Electrical Code, 1975 ed.

National Electrical Code Blueprint Reading, Gibert, 1974.

Electrical Blueprint Reading, Traister, 1975.

Electrical Trades Blueprint Reading, Vol. 1-3, Delmar Publish., 1961.

ILS Drafting: Electrical/Electronics, article 26.00

Drafting

Advanced Print Reading - Electrical

Riser Diagrams

Basic Components
Power Panel Schedules
Conductor & Conduit Indentification
Terms
The Basic Riser Diagram

Goal:

The student will be able to identify components or a riser diagram.

Performance Indicators:

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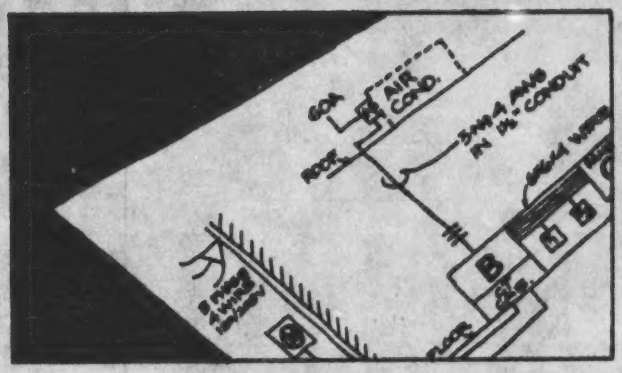
Introduction



Power riser diagrams are one of the more frequently used types of electrical diagrams for building construction. These diagrams show the relationship of the electrical components and how they are connected. Riser diagrams are simple to draw and easily read.

Information

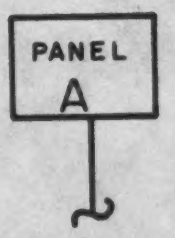
1. BASIC COMPONENTS

Most riser diagrams show the service entry, meter, and power distribution panel as their basic components.

The service entry may be in the form of a roof mount "weather-head" or an underground service. The symbol that indicates a weatherhead is shown below.

The service meter is usually mounted on an exterior wall below the weatherhead.

The power distribution panel may be a simple 200 amp service or a very complex panel for an industrial or commercial building. However complex, the panel is usually labeled or otherwise identified, and power panel schedule is used to identify the branch circuits.



2. POWER PANEL SCHEDULES

The power panel schedule is used in conjuction with the riser diagram to supply additional information for the electronic contractor.

The schedule usually includes a number identifying the circuit, circuit breaker or fuse amperage, wire size, electrical load data and remarks.

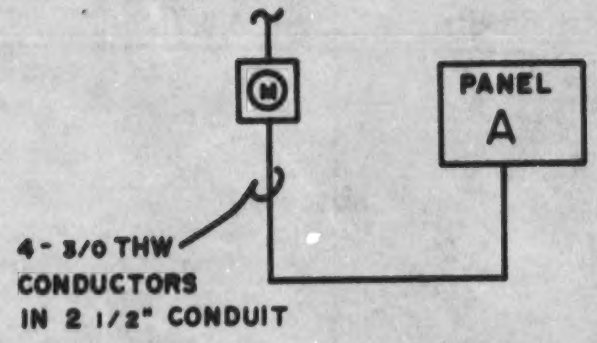
SCHEDULE FOR POWER PANEL "A"

Square Type NQ08 200 AMP Main Lugs Only 120/240V

CKT NO.	Circuit Breaker		Wire Size	Load in KW	Items Fed or Remarks
	Trip	Pole			
1	20	1	12	1400	Lights
2	20	1	12	1400	
3	20	1	12	1400	
4	20	1	12	1400	
5	20	1	12	1400	
6	20	1	12	1400	
7	20	1	12	1400	
8	20	1	12	1400	
9	20	1	12	1400	
10	20	1	12	1200	Receptacles
11	20	1	12	1200	
12	30	3	10		
13	30	3	4		
14					
15					
16					
17					

3. CONDUCTOR AND CONDUIT IDENTIFICATION

One of the primary purposes of the riser diagram is to show conductor sizes and conduit sizes. The actual labeling may vary, but the information is basically the same.



Wire sizes are given according to the American Wire Gage Standards.

Conduit sizes are given in diameter of tubing.

4. TERMS

Often the readability of any drawing depends on the proper use of technical terms and an understanding of these terms on the part of the reader. Therefore, some of the terms commonly used on riser diagrams are given below.

Branch Circuit - The circuit between the final circuit protection device and the outlets.

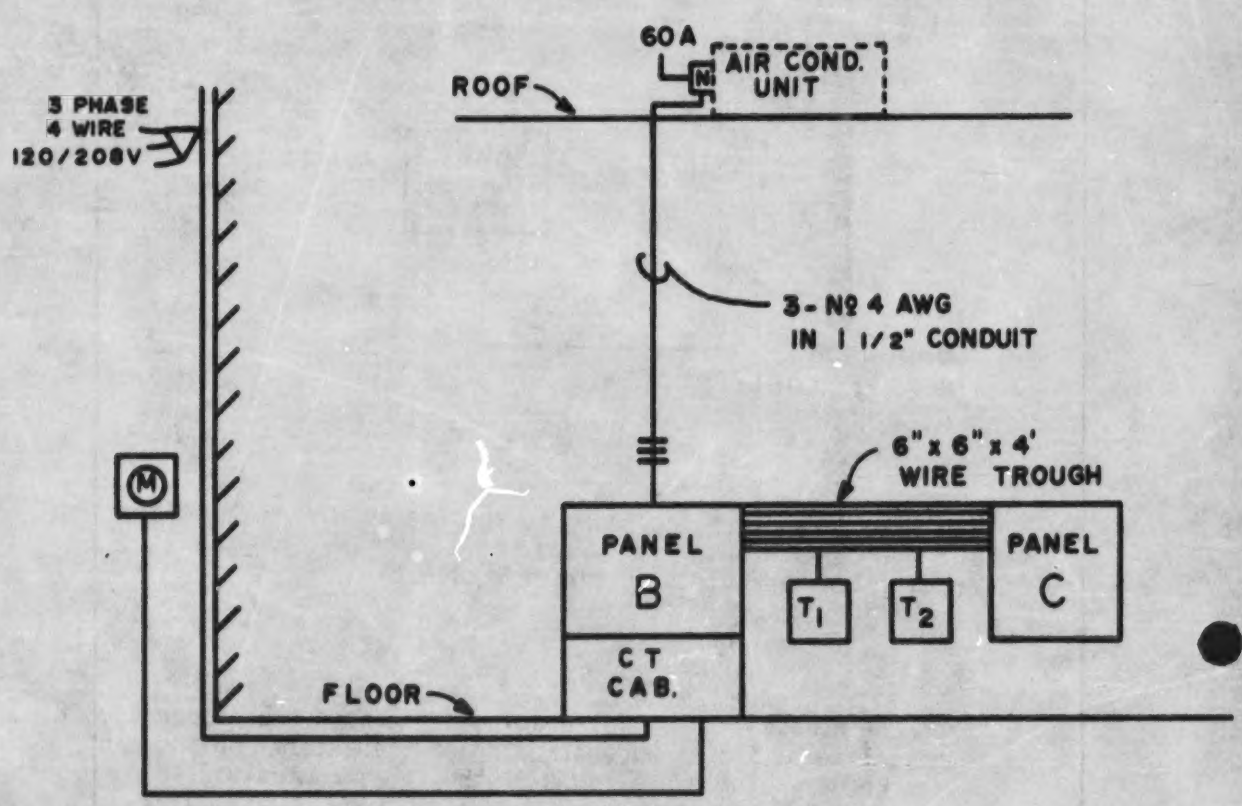
Feeder - The conductors between the service equipment and the branch circuit protection device.

Receptacle - A contact device for the connection of a single plug.

Service - The conductors and equipment used to deliver electricity to the wiring system of a structure.

5. THE BASIC RISER DIAGRAM

Shown below is a riser diagram for a small commercial building.



In the diagram above, the feeder lines run from the weatherhead to a current transformer panel (CT) and the main power distribution panel "B." There's an air conditioning unit on the roof that requires 240 volts, so a 1 1/2" conduit is connected from panel B to the unit via a disconnect device marked "N." This device is a main power disconnect for the air conditioner.

Panel "C" is an additional power distribution panel for some 240 volt equipment in the building. It is connected to panel "B" by a wire trough. Two booster transformers provide the additional voltage to panel "C."

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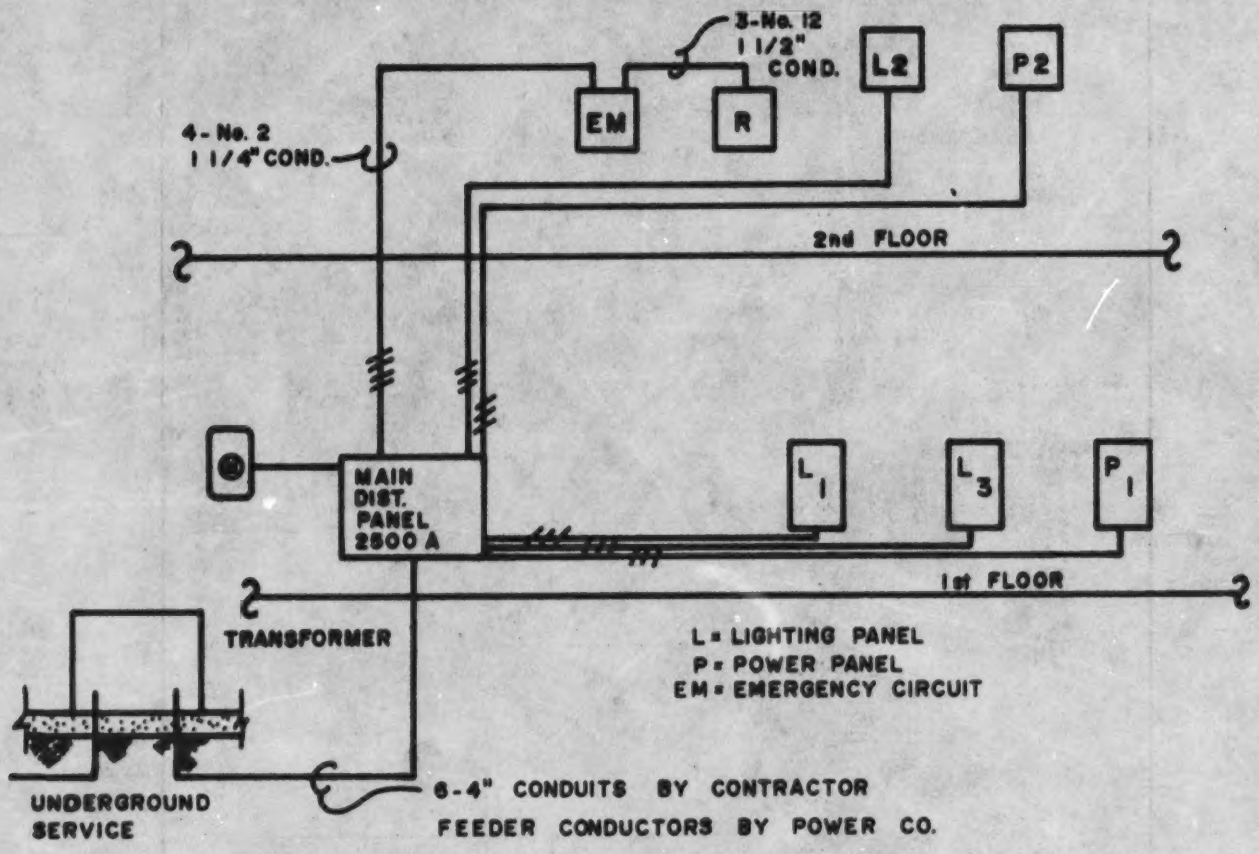
Self Assessment

Directions: Identify the components of the power riser diagram below.



(1) How many branch circuits are shown? _____

(2) How many three-wire conductors are shown? _____

(3) What diameter conduit runs from the main distribution panel to the emergency circuit panel? _____

(4) How many amps is the main distribution panel rated for? _____

(5) Instead of a weatherhead, what type of service equipment is shown? _____

Continued

(6) How many lighting circuit panels are shown? _____

(7) How many secondary power panels are shown? _____

(8) Name the device connected to the emergency circuit panel by 3 No. 12 conductors in a 1 1/2" conduit. _____

Answers: (1) six; (2) five; (3) 1 1/2 inch; (4) 2500 amps; (5) underground; (6) three; (7) two; (8) relay

Study Guide

For Further Information:

Electrical and Electronics Diagrams; The American Society of Mechanical Engineers, ANSI Y14, 15, 1969.

Electrical and Electronics Drawings, Baer, 1973.

National Electrical Code Blueprint Reading, Gibert, 1974.

Electrical Blueprint Reading, Traister, 1975.

Electrical Trades Blueprint Reading, Vol. 1-3, Delmar Publish., 1961.

ILS Drafting: Electrical/Electronics, articles 26.10, 26.20

Drafting

Schematic Diagrams

Basic Components
Mechanical Linkages
Terminals
Conductor Identification
Switch Positions
Component Identification
Examples

Goal:

The student will be able to identify and understand basic electrical schematic diagrams.

Performance Indicators:

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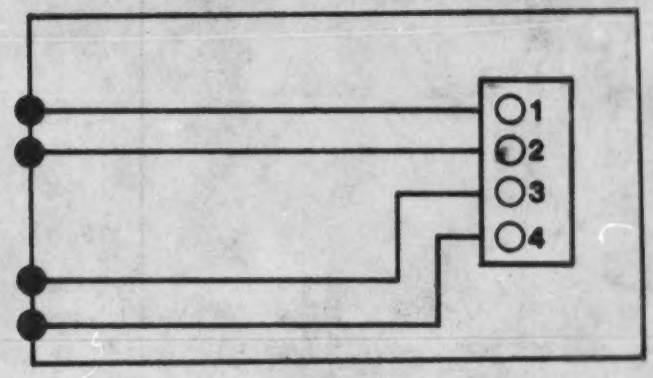
Introduction



Schematic diagrams are used for assembly, maintenance and analysis of electrical circuitry. They show components in their proper relationship to other components and circuit flow by using graphic symbols for the components. The circuit represented on schematic diagrams is the "theory" or relational circuit not the actual wiring or connection diagram for that circuit.

Schematic diagrams are used in control circuits, installation circuits and power distribution circuits to show the component and conductor arrangements for those circuits.

Information

1. BASIC COMPONENTS

Schematic diagrams are made up of component symbols and conductors. The electrical symbols covered in a previous module will be used to indicate components in the electrical schematic diagram.

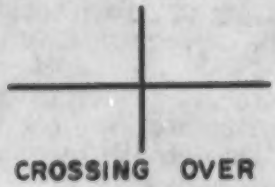
The exact composition of the schematic diagram will depend entirely on the circuits and hardware being shown.

Electrical schematics normally show switching circuits or power distribution circuits. Therefore, the number of different symbols shown in one drawing will be few.

Schematic diagrams generally follow the circuit, signal, or transmission path from input to output, source to load or in the order of functional operation. For example, a schematic might show the circuit flow from a battery to a lamp.

Conductor paths are shown as connector or crossing over each other by the symbols shown below.

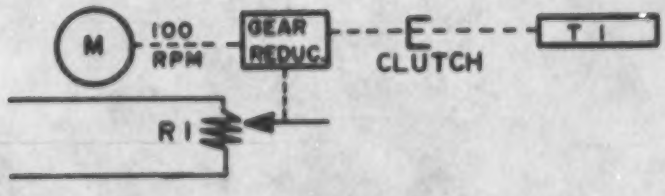
CONNECTING



CROSSING OVER

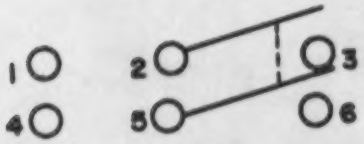
2. MECHANICAL LINKAGES

It is sometimes necessary to show mechanical functions such as rotation, braking or clutching as part of an electrical circuit. The mechanical components are linked to the electrical components by using a dashed line. An example is shown below.

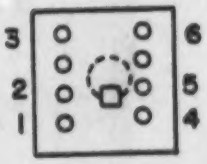


3. TERMINALS

Terminals of components are normally numbered according to numbers that already exist on the component itself or arbitrarily from some reference point on the component. An example of terminal identification is shown below. Notice that the terminals are shown in the schematic in a different arrangement than they actually appear on the component. The symbol for this component determines the terminal locations, not the component itself.



Symbol for a double-pole, double-throw switch as shown on a schematic.

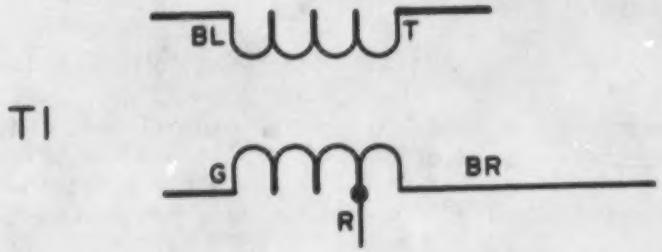


Actual component viewed from rear

4. CONDUCTOR IDENTIFICATION

On some schematics it may be possible to describe the actual wiring of the components instead of including a separate wiring diagram. However, it is usually customary to have both.

Conductors may be identified for wiring by color code, number, letter, or geometric symbol. In most cases, the easiest system to read and understand is the color code. Each wire or conductor is identified by a color code and its terminal or contact connections can be traced by following that particular color throughout the circuit. An example of color code marking is shown below.



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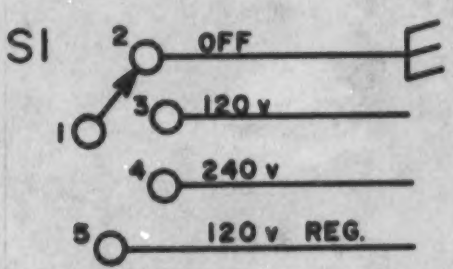
CONDUCTOR COLOR CODE ABBREVIATIONS

Color	Code	Abbreviations
Black	0	BK
Brown	1	BR
Red	2	R
Orange	3	O
Yellow	4	Y
Green	5	G
Blue	6	BL
Violet	7	V
Gray	8	GY
White	9	W

5. SWITCH POSITIONS

On schematic diagrams it may be useful to identify the circuit control function for each position on the switch, for example, "on" and "off." For more complicated switches, the function may be shown on the drawing itself or on a table or legend somewhere else on the drawing.



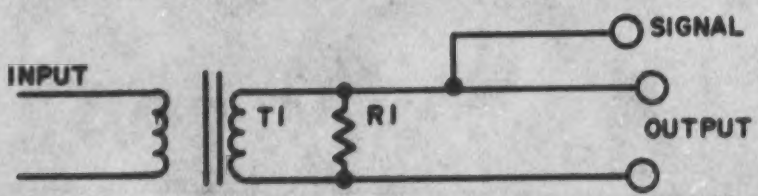
Functions shown on symbol in a schematic diagram.

S1 VOLTAGE CONTROL	
FUNCTION	TERM
OFF	1-2
120 v	1-3
240 v	1-4
120 v REG.	1-5

Table showing switch functions

6. COMPONENT IDENTIFICATION

Components in an electrical schematic are identified by a letter and number. The numbers are assigned sequentially for similar components, and read from left to right and top to bottom. For example, the first transformer in a circuit would be identified by the letter "T" (transformer) followed by the number "1."



C8

The particular size of the component or rating may also be shown. Such as ohms for resistors and volts for power supplies.

COMPONENT IDENTIFICATION LETTERS

A = Antenna

BT = Battery

CB = Circuit Breaker

F = Fuse

HR = Heater

L = Inductor or Winding

DS = Lamp

C = Capacitor

B = Motor

Y = Oscillator

K = Relay

S = Switch

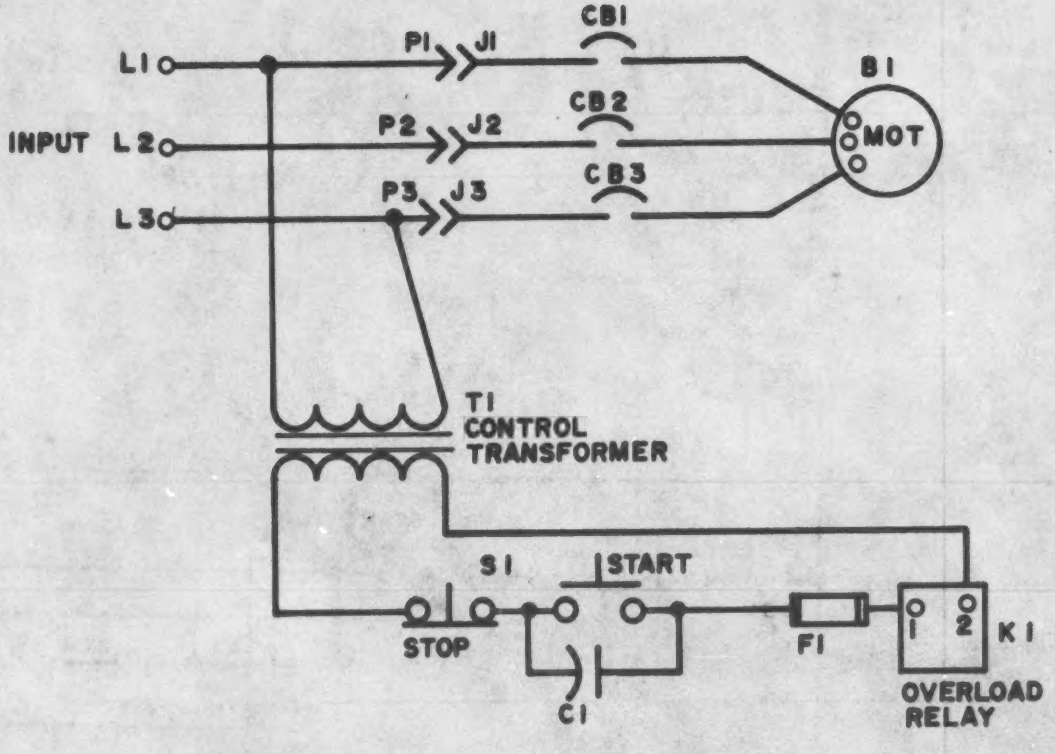
TB = Terminal Board

T = Transformer

R = Resistor

7. EXAMPLES

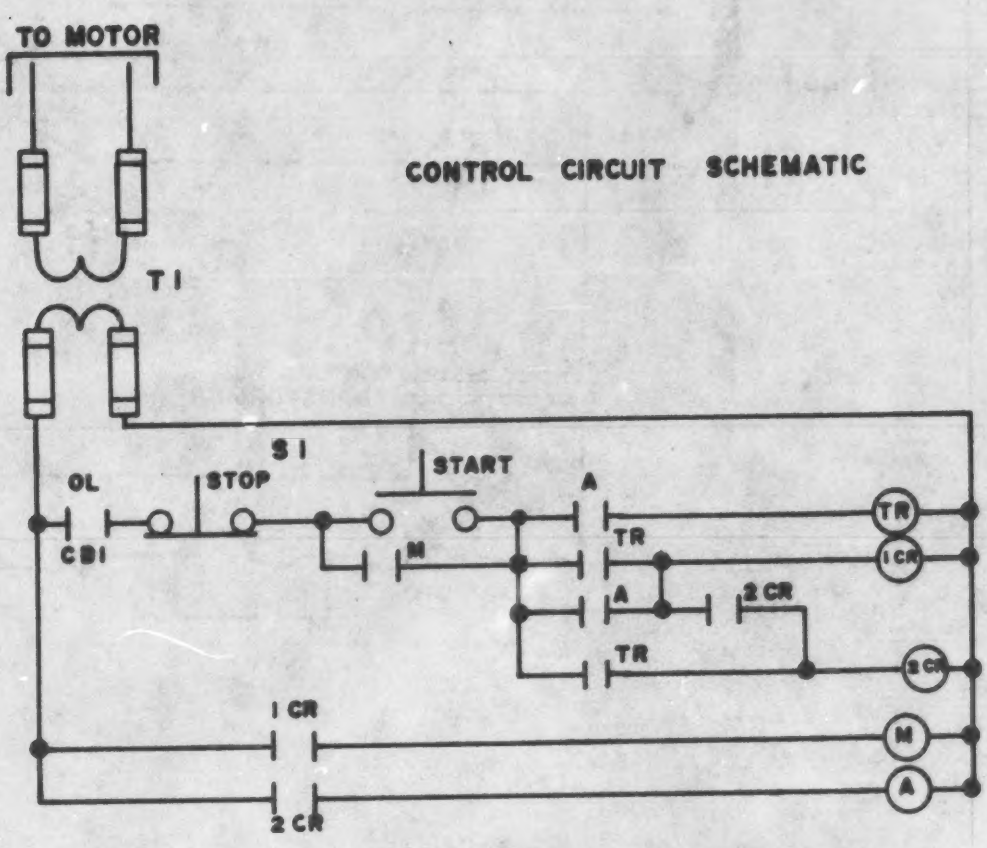
An example of a basic schematic diagram is shown on the next page.



The designations L1, L2, and L3 are input leads to this circuit. The circuit shown is part of an industrial control system and the contacts and leads for L1, L2, L3 are shown on other schematics for this system.

Notice the rocker type start-stop switch (S1). The disconnects at P1 through P3 and J1 through J3 are for disconnection of the circuit from the motor and protection box which houses the circuit breakers.

Another simple schematic diagram of a control circuit is shown below.



CONTROL CIRCUIT SCHEMATIC

Contactors
M = Main Contactor
A = Accelerating Contactor
TR = Timing Relay
1CR = Auxiliary Control Relay
2CR = Auxiliary Control Relay
OL = Overload Relay
TC = Time Closing Contact

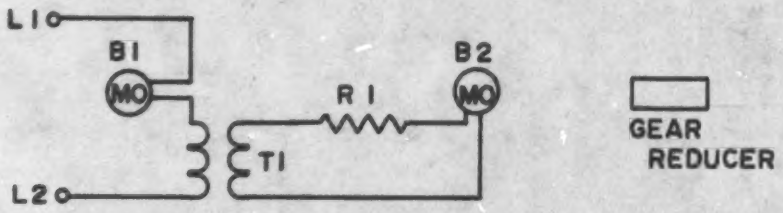
The symbol shown for a contactor and relay has several meanings. The table shown identifies the characteristics of that component.

Self Assessment

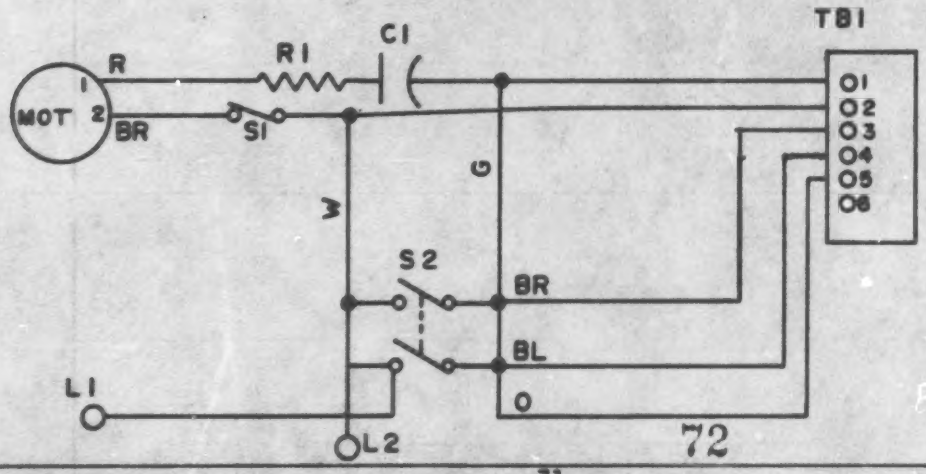
Directions: Provide the answers requested for the following.
Check your answers with those on the next page.

(1) Complete the diagram to indicate that conductor one is connected to conductor two.

(2) Complete the diagram to show that the gear reducer is mechanically linked to Motor 2.

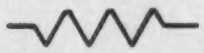


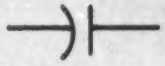
(3) Trace the black wire from terminal two of the motor to the terminal board. What is the number of the terminal it is connected to? _____. (See diagram on next page.)



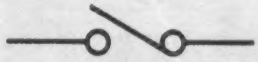
72

(4) Use the proper letter to identify the following symbols. Place your answer in the blank below the symbol.

(a) 

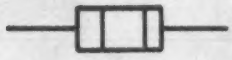
(b) 

(c)

(d) 

(e)

(f)

(g) 

(h)

Answers:

(3) 2; (4a) R; (4b) C; (4c) T; (4d) S; (4e) BT; (4f) CB; (4g) F; (4h) B.

Study Guide

For Further Information:

Electrical and Electronic Diagrams, The American Society of Mechanical Engineers, ANSI V14.15, 1969.

Electrical and Electronics Drawings, Baer, 1973.

National Electrical Code Blueprint Reading, Gibert, 1974.

Electrical Blueprint Reading, Traister, 1975.

ILS Drafting: Electrical/Electronics, article 26.70

FINAL QUIZ IS AN INDUSTRY DRAWING!

74

INSTRUCTIONAL LEARNING SYSTEMS

Drafting

Special Applications

Power Distribution
Industrial Control Circuits
Alarm Circuits
Telephone Switching Circuits

Goal:

The student will be able to read some of the special applications of electrical drawings.

Performance Indicators:

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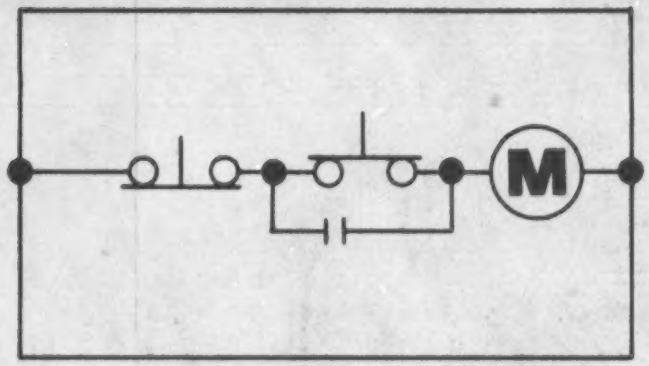
Introduction



There are many types of electrical drawings that don't fall into any particular categories. They are drawings that may use some form of block diagram, like that used with riser diagrams, or they may be more on the order of the schematic diagrams.

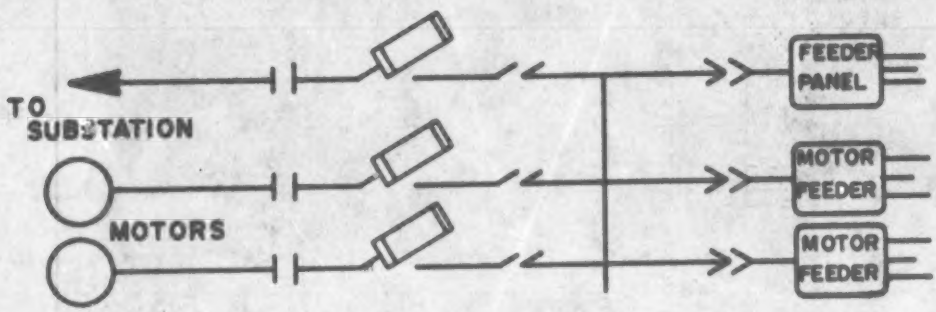
Special circuits may include the control circuit for a fire alarm system or an electrically controlled sprinkler system, or they may be the main power distribution circuits of power substation. In any case, they all use some of the symbols and techniques discussed in previous modules, so they should not be considered a new type of drawing.

Information

1. POWER DISTRIBUTION

In general, power distribution circuits include all electrical drawings. However, for simplicity, the circuits will discuss will be those dealing with major power supply and distribution circuits for a structure.

Power distribution circuits are generally drawn in a simplified block-type diagram, or with a combination of schematic component symbols and block symbols. For example, plugs, fuses, circuit breakers, transformers and relays may all use a schematic type symbol, while motors, generator and control panels may use circles or rectangles. The example below shows a portion of a circuit. Notice the difference in the symbols.

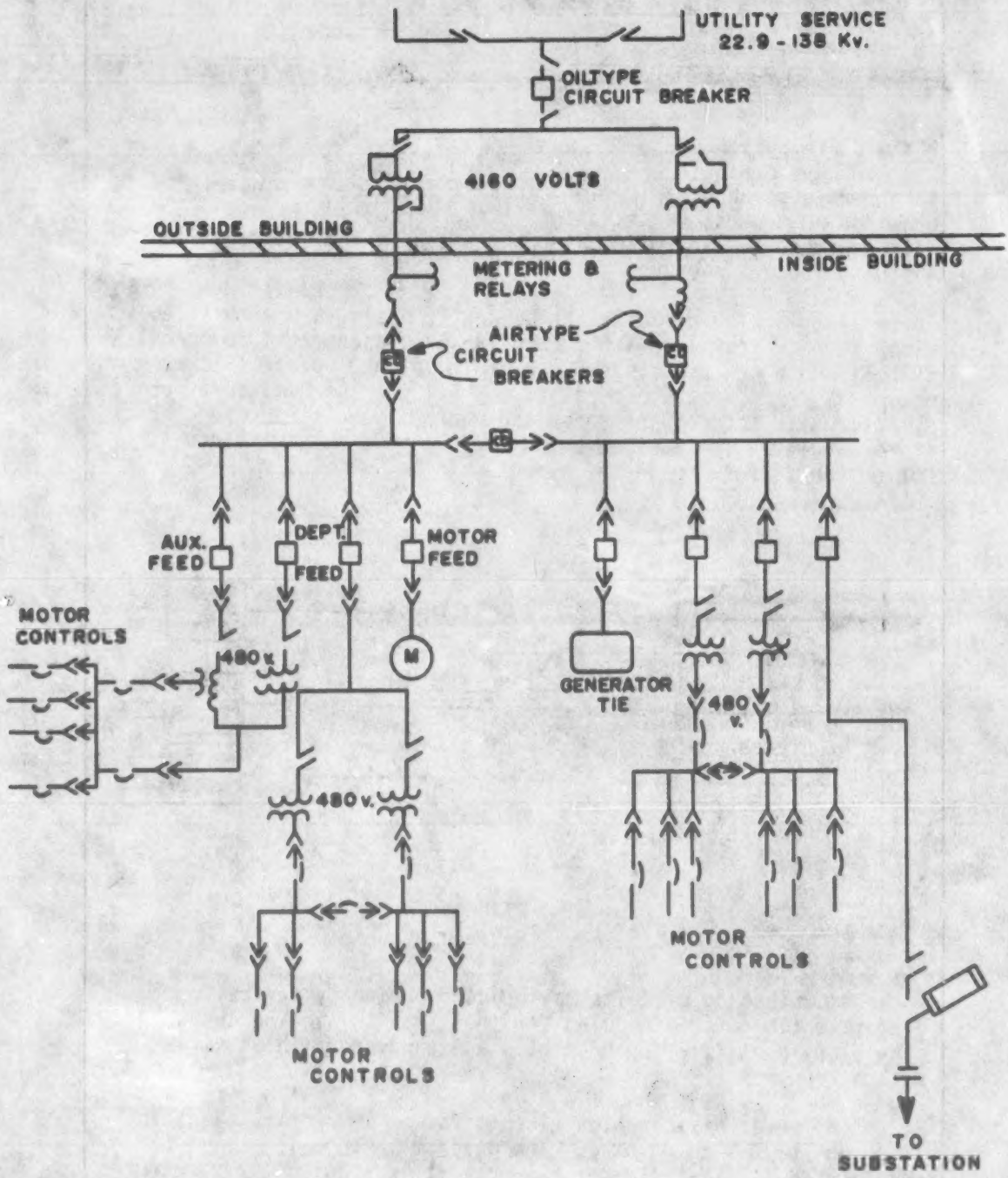


Power distribution circuits may be accompanied by several elaborate tables or schedules for the circuitry in the control panels or identification of cables and conductors in massive wiring troughs.

A typical power distribution circuit for an industrial plant is shown on the following page. The diagram looks quite complicated at first glance; but once it is studied for a moment and broken down into small parts, it becomes very simple.

TYPICAL INDUSTRIAL POWER

DISTRIBUTION DIAGRAM



2. INDUSTRIAL CONTROL CIRCUITS

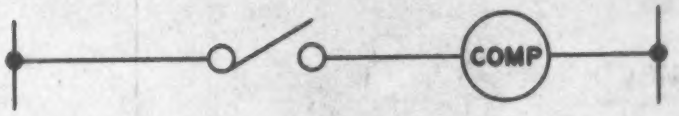
An electrical controller is a device or group of devices which governs or controls electrical current delivered to electrical components. They may include components such as circuit breakers, relays, motor-circuit switches and contactors.

Motor-circuit switches are used to interrupt power or current to a motor or starter during overload situations.

A contactor is used to make frequent or repeated on-off type switches of current to a component.

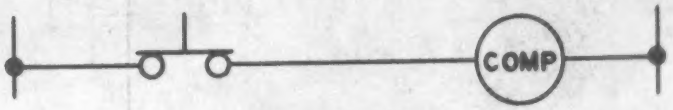
Control circuit functions are very basic, but most essential in electrical circuits. They are: starting, protection, running, speed regulation and stopping.

Some of the basic circuits for control are shown below.

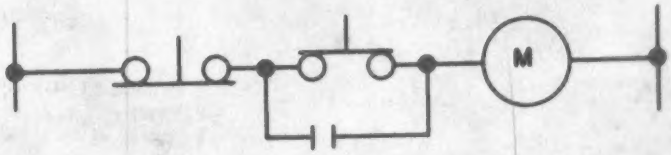


Single knife switch

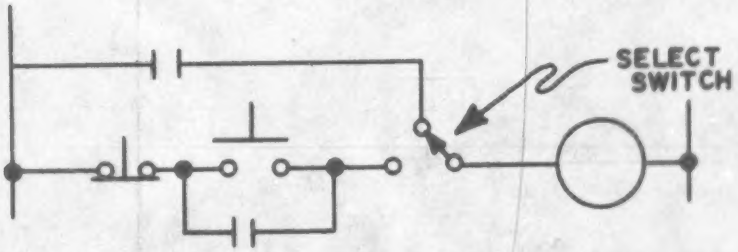
Automatic pressure switch



Push button switch



Momentary contact push button

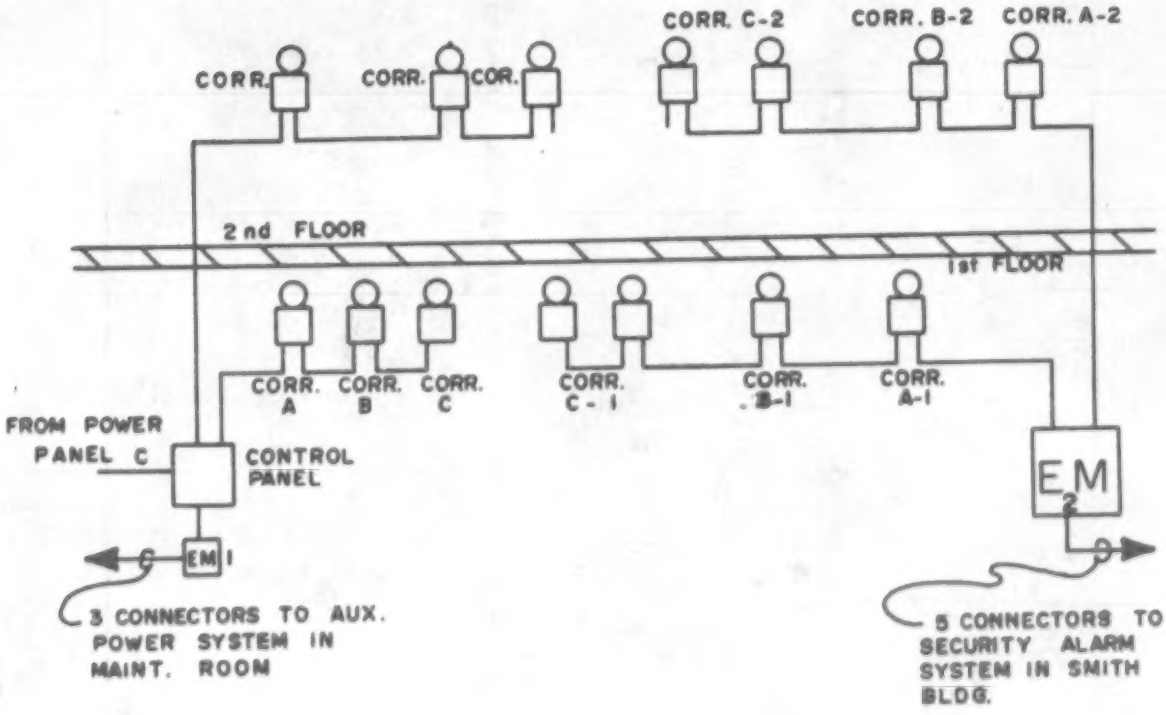


Selector switch Z wire and push button

3. ALARM CIRCUITS

Alarm circuits for fire, security and warning systems are another special application of electrical drawings. In most cases, the simplicity of alarm circuits allows the use of riser diagrams to explain the circuit. All alarm circuits need to have an emergency circuit to supply power during emergency power outages. Emergency panels are normally designated as "EM."

In a large building, there may be several separate circuits and many alarm devices. The exact location of each device must be shown in a schedule or table and not on the drawing. However, if the building is small or moderate in size, the location of the devices can be shown on the drawing. A riser diagram for an alarm system is shown below.

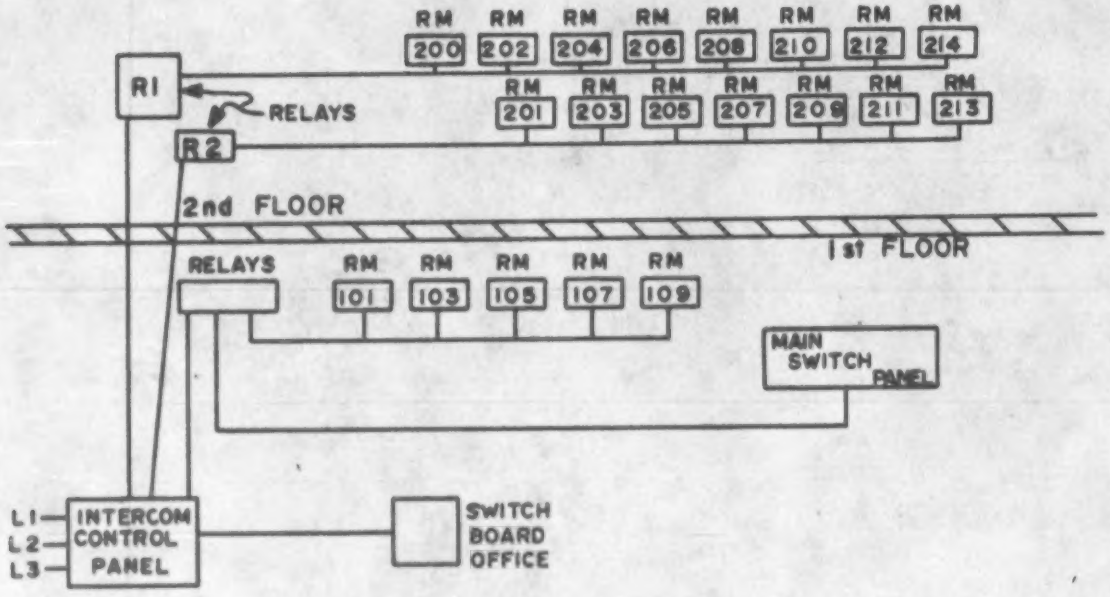


SECURITY ALARM CIRCUIT

Notice that this system has a backup circuit connected to the security system of another building.

4. TELEPHONE SWITCHING CIRCUITS

Since most telephone switching circuits have incorporated elaborate integral electronic circuits, the reason for discussing the old style relay systems is that they are still used for some intertelephone circuits or intercom circuits. A simple telephone switching circuit, in riser diagram form, is shown below.



MOTEL TELEPHONE SWITCHING CIRCUIT

Self Assessment

Directions: Complete the following questions. Check your answers with those on the next page.

(1) A circuit that shows incoming electrical current from a power plant and all the dispersal circuits within a building would be a _____.

(2) Starting, protection, running, speed regulation and stopping are all functions of an industrial _____ circuit.

(3) Devices used to interrupt power to a motor or starter during overload situations are _____.

(4) A device used to make frequent or repeated on-off switching of current to component is a _____.

(5) _____ circuits need to have an emergency circuit to supply power during emergency power outages.

Answers to Self Test

(1) Power Distribution Circuit

(2) Control Circuit

(3) Motor-Circuit Switches

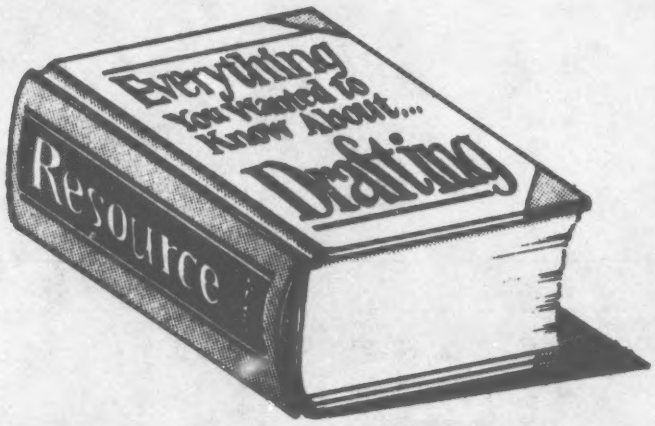
(4) Contactor

(5) Alarm

FINAL QUIZ IS AN INDUSTRY DRAWING!

Study Guide

For Further Information:



IEEE Standard and American National Standard, Graphic Symbols for Electrical and Electronic Diagrams, 1971, ANSI V32.2.

Electrical and electronics Drawings, Baer, 1973.

National Electrical Code, 1975 ed.

National Electrical Code Blueprint Reading, Gibert, 1974.

Electrical Blueprint Reading, Traister, 1975.

Electrical Trades Blueprint Reading, Vol. 1-3, Delmar Publish., 1961.

ILS Drafting: Electrical/Electronics, article 26.00

• Post Assessment

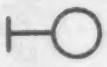
Advanced Print Reading
Electrical

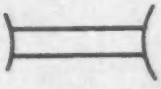
Final Quizzes

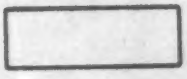
NAME_____

Basic Architectural Electrical Symbols

Directions: Identify the following symbols.

(1) 

(2) 

(3) 

(4)

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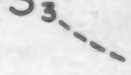
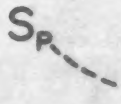
(6) 

(7) 

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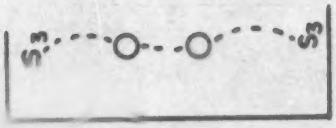
(9)

86

(10)

(11) 

(12)

(13)

(14)

(15)

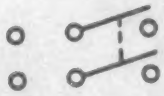
87

NAME_____

Wiring Symbols

Directions: Identify the following symbols.

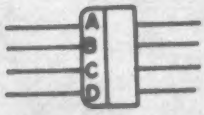
(1)

(2) 

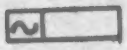
(3)

(4)

(5)

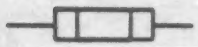
(6) 

(7)

(8) 

(9)

88

(10) 

(11)

(12)

(13)

(14)

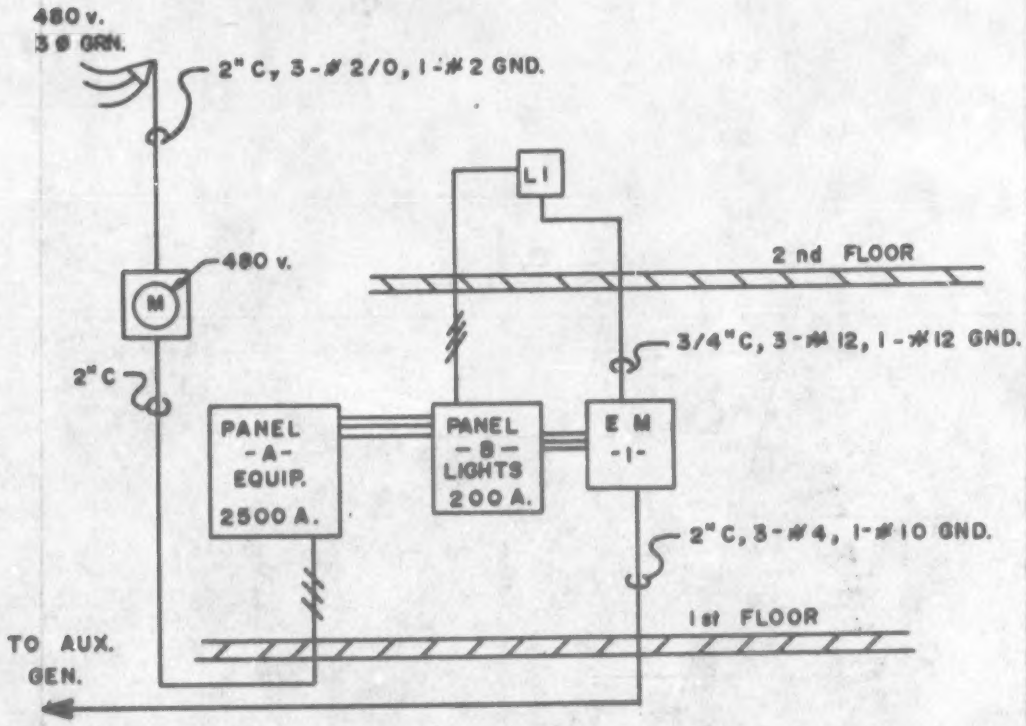
(15)

89

NAME_____

Riser Diagrams

Directions: Refer to the riser diagram below to answer the following questions.



(1) How many branch circuits are shown?_____.

(2) What size conduit is used between the weatherhead and the service meter?_____.

(3) What size ground wire runs from the emergency panel to the auxiliary generator?_____.

(4) How many amps is the lighting panel rated for?_____.

(5) What size conductors are used between L1 and EM1?_____.

(6) What size conduit runs from the service meter to panel A?
_____.

(7) How many four wire conductors are shown?_____.

(8) How many three wire conductors are shown?_____.

(9) Power riser diagrams show service panels and _____ panels for power distribution to buildings.

(10) The conductors between the service equipment and the branch circuit protection device are called _____.

NAME_____

Schematic Diagrams

Directions: Refer to the industry drawing marked E1 to answer the following questions.

(1) How many feed pump starter circuits are indicated on the drawing?____ _____.

(2) Selector switch #9 is normally (on, off). Circle one.

(3) Pressure switch 1512 closes when pressure drops to _____ P.S.I.

(4) What color lense does light #4 have?_____.

(5) How may contact relays are shown?_____.

(6) Motors 8, 9, 10, 11 and 12 all have _____ volt power inputs.

(7) What type of switch is shown at (A)?_____.

(8) What is the input voltage to circuit #1?_____.

(9) Cam Timer #2 is (normally open, normally closed). Circle one.

(10) What does the symbol at (B) indicate?_____.

NAME_____

Special Applications

Directions: Refer to the industry drawing marked E2 to answer the following questions.

Note: MCC-1A is a main electrical power control panel for small water treatment facility.

(1) From the "plant one-line diagram," what is the input electrical service for MCC-1A?_____.

(2) What does the symbol at (A) represent?_____.

(3) What size conduit is used between the control panel and LS-302?_____.

(4) How many 1" conduits are left empty for the telephone company?_____.

(5) What does the symbol shown at (B) represent?_____.

(6) What does "G.F.I." stand for in the note at (C) ?_____.

(7) What does "N.E.C." stand for in the note at (D) ?_____.

(8) What piece of equipment is wired into the MCC-1A space indicated at (E) ?_____.

(9) What size ground wires are used in the four conduits from the heat tracing junction box to the MCC-1A?_____.

(10) How many #12 wires are used between the receptacle and junction box shown at (F) ?_____.